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ABSTRACT

This manual provides teacher educators with a broad perspective on educational technology to ensure that environmental education is enhanced not compromised by new information and communication tools. The manual puts technology problems and promises in perspective and contains sections that review educational philosophy and instructional techniques related to interactive multimedia and on-line learning. Handouts and overheads for teacher workshops are provided. A resources section offers assistance to workshop participants and leaders. It contains references to over 100 resources in the following areas: educational technology journals and trade publications, organizations and institutions, books, multimedia and on-line learning resources, general software and multimedia catalogs, environmental education software and multimedia catalogs, network service providers, networked projects and resources, environmental database resources, product reviews, and the greening of computers. A glossary of computing terms is provided. (LZ)

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Using Computers in Environmental Education: *Interactive Multimedia and On-Line Learning*

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Toolbox

EE Toolbox—
Workshop Resource Manual

Using Computers in Environmental Education: *Interactive Multimedia and On-Line Learning*

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This unit provides teacher education with a broad perspective on education and technology, one designed to ensure that environmental education is enhanced — not compromised — by new information and communication tools. Focusing on two of the most promising computer based tools, interactive multimedia and on-line learning, this unit includes background and support for the timid beginner as well as coverage of the latest trends for veterans. Resources and activity ideas are included.

Introduction

WELCOME TO THE COMMUNICATION AGE. Step right ahead into an era:

- full of expensive and potentially intimidating equipment;
- where most 13-year-olds know a lot more than their teachers about technological tools;
- where few environmental educators understand the present and even fewer have a clear view of the near future;
- that perhaps offers more potential and power than ever before to create an inspired, informed, and active environmental citizenry;
- of extreme excitement and uncertainty when environmental educators are just beginning to explore the problems and promises of computer-aided environmental education.

"Even if you're on the right track, if you don't keep moving you'll get run over."

Will Rogers

There are several challenges for those of us who offer training in computer-aided environmental education (EE).

First, we need to provide learners with a comprehensive, critical, and yet visionary analysis of the link between EE and educational technology. This analysis reminds us that technology is only a tool — and a tool is only as good as the craftperson who wields it. Any introduction to this field must caution the audience about the natural tendency to let the lure of new technology override our otherwise deliberate choice of effective approaches to teaching and learning.

After establishing a philosophical basis, we need to get down to the practical, nitty-gritty basics by providing the essential hands-on training teachers need in a new arena. Then we need to facilitate hassle-free access to tools educators can use *now!*

And perhaps the greatest challenge is to accomplish all of this in a way that will lead to more smiles and nods of understanding than glazed-over eyes and looks of intimidation.

A regularly updated version of this unit is available on-line.
Gopher to EE-Link at: "nceet.snre.umich.edu" (see page 26 for more on Gopher).
The World Wide Web address for EE-Link is: http://www.nceet.snre.umich.edu

Computer-aided EE is a field where keeping abreast of changes is a must. This document is intended as a point of departure. By the time it is in print, new computer resources will be available and some of what is described here may already be out of date. The landscape is changing daily. Will Rogers offered a bit of wisdom that applies to training in this field: "Even if you're on the right track, if you don't keep moving you'll get run over."

Computer-aided EE was unimaginable when delegates at the 1977 United Nations Intergovernmental Conference in Tbilisi, Georgia, USSR, adopted a definition of environmental education. Since that time, the concept of enhanced personal productivity, based on desktop computers, has rapidly given way to metaphors of information highways and virtual communities. The arrival of palm-sized wireless devices, multimedia-capable laptops, virtual reality headsets, and voice-driven computing – all in the last couple of years – promises continuing waves of change in how we can teach and learn.

So fasten your seat belt, turn on your hardware, dial into the Internet, double-click on a multimedia application, query your database, access that CD-ROM, hook up your fiber optics, and get ready for digital video satellite reception. The following pages provide a helpful roadmap for maneuvering your way on an environmental journey through the Communication Age.

Problems and Promises in Perspective

I

ANY TEACHER WORKSHOP on computer-aided environmental education may be a somewhat schizophrenic experience. You need to communicate that on one hand, there are potential problems with using computer technology for EE. On the other hand, computer-aided EE promises to enhance the effectiveness and benefits of our field.

In Texas, middle school students in the Global Laboratory Project sampled their school's indoor air with a low-cost monitoring device, and communicated the results to scientists and student peers around the world using a computer and modem. When the students' extremely high carbon dioxide numbers arrived via electronic mail, their on-line mentors were convinced that the testing was done incorrectly. After a repeat sampling confirmed the result, state experts were summoned. With instruments costing thousands of dollars more, they got the same result, and immediately ordered repairs in a faulty ventilating system that had exposed all students and teachers at the school to potentially dangerous conditions.

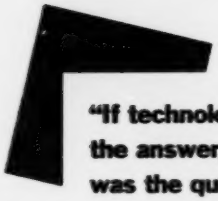
Students in Maryland participate in the Greenbrier Aquatic Studies Program, an educational endeavor that mixes low-tech field trips with high-tech analysis. Field trips to state parks include water tests and fishing lessons. Once the students return to the classroom, they sit down at computers to analyze data and review information on topics like fish and water life using computer-aided multimedia software. Funded by the local utility, the Maryland Department of Natural Resources, and a local computing firm, this program that began with one classroom now includes more than 2,000 students.

A group of junior high students forms a campus ecology club. To share their interests and concerns, they create several interactive multimedia programs, blending images from a commercial laserdisc, digital snapshots they took in the local community, and images they downloaded from the Internet. The multimedia programs are shown to nearby elementary school classes as well as the PTA.

Decades of road building, farming, logging, and mining have taken their toll on watersheds throughout the United States. Facing the massive task of restoring water quality and fish habitat, scientists and land managers from federal and state agencies, corporations, schools, and citizen groups are sharing their knowledge and expertise in a national effort — via an Environmental Protection Agency Non-Point Source computer bulletin board. Any individuals, groups, or schools now can tap this free collective resource to gather ideas for developing effective water-quality strategies for their own watersheds.

No doubt about it, the Communication Age has introduced significant new teaching tools as well as new twists to old tools. In spite of the fundamental problems, computer-aided EE presents a whole new set of extremely powerful ways of promoting, as perhaps never before, the goals and objectives of EE.

The new technology allows teachers, students, and in-service professionals to reach out to the wider world to research information, to collaborate with their peers (even internationally), and to analyze and present their information — both for their own education and to create positive change.



"If technology is the answer, what was the question?"

Descriptions of technology's new tools, models for their use, and references for further exploration are listed in later sections of this manual. But the reality of any technological change in society is that the praises are often sung too loudly and there is often good reason to criticize new technologies that come with scant proof that they can yield the wonders attributed to them.

While there are many examples of successful and effective computer-aided EE, they must all be viewed in light of some fundamental questions about the impact of technology. These questions of technological misapplication, inequity of access, environmental substitution, and environmental impact lie at the heart of the emerging field of computer-aided EE. (See page 42 for a one-page summary of the following four "Problems in Perspective.")

Technological Misapplication

It was "Community Day" at a recent conference of the American Association for the Advancement of Science (AAAS), and hundreds of school kids had come to visit the conference display hall, replete with the latest high technology for teaching science. Millions of dollars worth of hardware and software was buzzing away, offering exhibitors the latest tools to impress "the MTV generation." In the same giant hall, a small non-profit EE organization had a display with no whizbang gadgets, but one live "non-releasable" hawk. The hawk display was constantly surrounded by five times as many kids as any of the others!

Although we are perhaps being unwittingly zapped into the Communication Age, it doesn't mean we had to erase our logic and memory banks along the way. We need to remind ourselves that just because a new technology exists doesn't mean we must use it or that it is necessarily the best way to educate and communicate. Just because we have a new set of hammers, doesn't mean that everything becomes a nail.

We also have to remind ourselves that "using" a computer is different from "learning" with a computer. We must not mistake interest in technology with learning and transferability. To date there has been little critical thinking, complex decision-making, or evaluation in computer-aided instruction. It is not that there cannot be, it is rather that using computers to encourage real thinking (instead of simply providing answers) is a challenge we have not fully addressed, perhaps due to enamoration with the technology.

WHETHER we choose to use educational technology, ***HOW*** we use it, and ***WHEN*** we use it, are critical decisions. Before we give way to the seemingly inevitable wave of computer-aided education, let's be sure that we are only willing to utilize

these new tools as a means to achieve the guiding principles of EE. The best computer-aided environmental education is achieved when we do not allow the misapplication or inherent limits of technology to compromise what we know about how people learn best. (If you need a reminder of the principles, see page 6 of "Defining Environmental Education" in the *Workshop Resource Manual.)*

Inequity of Access

In the technology center of a well-to-do suburb of San Francisco, students sit down at one of the school's 30 computers or plug in a laptop computer brought from home. The teacher, using a color LCD display connected to her computer, projects on a large screen the options from which students can choose. Using the school's integrated network, they can choose to 1) connect to one of the new CD-ROM or laserdisc players to explore the latest products in the school's environmental multimedia library, 2) connect by high-speed modem to the Internet and search databases related to their term paper topics, or 3) use a scanner to digitize graphic images that can be used later when they desktop publish their term papers.

In another classroom across the San Francisco Bay, students sit down to desks that wobble and creak, scrounge for slips of paper to write on, and share a stubby pencil with no eraser. The teacher uses the last piece of chalk from a box she had to buy with her own money because the district materials budget is once again "running in the red."

Access to new educational technologies is increasing rapidly, but not for everyone. While the average number of computers per classroom continues to skyrocket and today there is a 12:1 student-to-computer ratio in U.S. schools, the ratios are much worse in areas where educational programs are poorly funded (Anderson, 1993). Limited availability of training and technical support for teaching staff can further impede computer-aided education.

In light of those barriers, who can afford to participate? Will computer-aided education widen the gap in the quality of educational services accessible to students and teachers in districts with different economic status?

Environmental Activity Substitution

Conversation recently overhead in a teachers' lounge...

Chris: "Hey Robin, when should we plan to take our students on our annual field trip to the wetlands? We've got to schedule the car pools, gather up a bunch of binoculars and water test kits, and oh yeah, are you still willing to borrow your neighbor's canoe?"

Inequity of access is a critical problem that must be addressed as we move forward into the Communication Age. For computer-aided environmental education to be effective, it must be affordable and accessible to all.

Robin: "Gee Chris, I'm really not into a wetlands field trip anymore. Not since our school got that great new interactive laserdisc on wetlands. It shows a lot more birds than we ever saw. It even plays bird calls and shows those weird bottom-dwelling insects we could never seem to find! And, hey, no more muddy boots or wet clothes. I hear there is a new tidepool CD-ROM being developed too. I'm hoping I can use it as a substitute for our annual beach trip."

Computer-aided EE could be viewed as a cost-effective, time-saving, and academically sound replacement for direct contact with the biophysical environment. Why take a field trip to the wetlands when you can use an interactive software program on wetlands? Why gather first-hand data on climate or water quality when you can get it through an on-line database? Why go bird watching when you can access a laserdisc of 50,000 color slides of birds, cross referenced and selected at the push of a button?

How to Make Compu-Stew

In a very large bowl, mash up what is probably the largest single source of chlorofluorocarbons; throw in reams and reams of wasted paper; chop up a bunch of quickly obsolescent machines for added crunch; add the fastest-growing source of electrical energy consumption; spice with a few zillion batteries full of lead, cadmium, and mercury. Oh yeah, be careful when stirring your stew, because the production of high-technology components makes useof toxic gases, solvents, heavy metals, and volatile organic compounds that can harm workers, communities, and the environment.

Stratospheric ozone-destroying chlorofluorocarbons (CFCs), used as a solvent to wash residue from printed circuit boards, are being rapidly phased out (better late than never). Apple, Compaq, DEC, Fujitsu, IBM, and Intel all are eliminating CFCs — and in the process saving millions because they are avoiding the costly purchase and disposal costs of chemicals.

While the reduction, reuse and recycling of paper is perhaps the easiest environmental problem to address, the quantity of paper use in the United States has doubled since 1976, the year the Apple II was introduced. In 1994 we still are recycling only about 15-20% of office paper waste, according to the U.S. Conference of Mayors' National Office Paper Recycling Project. One disincentive to paper recycling is the fact that paper run through a laser printer is worth 10-25% of plain paper that has been through an impact printer because the laser toner is so difficult to remove. Rumor has it that new processes to de-ink the 60% of office paper now laser printed are on the horizon.

Better progress has been made in recycling the components of obsolete machines. According to Ethan Seidman, a researcher for *Garbage* magazine, when a computer enters the waste processing stream, it is usually stripped of all salvageable or recycled parts so that "nothing is left when the crows are done picking." One exception is the picture tube in monitors which must be disposed of as an expensive hazardous waste. Printer cartridges now are recycled routinely.

As environmental educators we must undertake an especially critical and comprehensive environmental impact analysis of these educational technologies. Once we do, we'll realize that only judicious use can result in a positive net impact on the biophysical environment.

The more time we spend at a computer, the less time we may spend interacting with other people and/or the biophysical environment. At what point does increased computer use become an artificial and unproductive substitute for interaction between people and the natural world?

Environmental Impact

We must be realistic about the impact of high-technology processes and products on the environment. While computers are often touted as a "clean" industry, a comprehensive cradle-to-grave view of their impact can be a sobering experience for computer users who see themselves as "green." The good news is that significant progress has been made in recent years, primarily because both vendors and consumers are finding that environmentally sound computing pays. (A one-page summary sheet, "Anatomy of a Green Computer User" can be found on page 44.)

Computing is not as "clean and green" as we might initially believe (see box above, "How to Make Compu-Stew"). While there are serious environmental problems associated with these technologies, recent advances and an aggressive stance on the part of most manufacturers hold promise for significant improvement.

While many arguments can be made about how computers save energy (fossil fuels used in transportation are saved by telecommuting, microprocessor energy management systems save heating and cooling energy in buildings, tiny computers save gasoline in new automobiles), the rapidly increasing number of computers and printers exerts a huge new demand on energy resources. Scientists at Lawrence Berkeley Laboratory estimate power consumption from typical office computing to equal the demand of lighting, which historically has been the largest single consumer of electricity. Add to this the increased costs of cooling the building in which the computers are located.

Fortunately, new technologies can radically reduce the electrical demand associated with computing. The U.S. Environmental Protection Agency's "Energy Star" program identifies desktop computers that incorporate a sleep mode capacity which when compared to a typical computer lowers total power consumption by 70%! If you use a similarly equipped laptop computer with an active-matrix color screen, you've reduced your consumption by 93%! By the way, ink-jet printers, while slower than lasers, use 80% less standby energy and 97% less in printing energy than laser printers!

Finally, there are those lowly batteries. Most desktop personal computers use a battery to back up system memory, and nearly all battery powered portables and notebooks use rechargeable nickel-cadmium batteries for system power. They may not seem like much, but batteries alone constitute about 20% of the hazardous waste generated by U.S. households and offices. Some computer vendors are now offering a battery recovery program for their portables and notebooks where they accept used batteries at their service providers and then pay the full cost of recycling or "proper" disposal. The long term solution is to use newer battery types that don't contain cadmium.

New technology has the potential to change the ways that information is discovered, shared, and processed. We have reviewed several problems with using computers in education, but computer-aided education also offers unique opportunities. Computers can help redefine the interaction between students and teachers, give students alternative modes of expression, and give users greater access to the world. See page 43 for a summary, "Promises in Perspective."

Teachers can move from being "sages on the stage" to "guides by their side," becoming managers and facilitators who can spend more time engaged in creative, individualized instruction.

New Definitions for "Teacher" and "School"

At a recent National Science Foundation conference on the use of Geographic Information Systems in education, a teacher from Thomas Jefferson High School in Alexandria, Virginia described how much guts it took to change from a traditional provider of information and a gatekeeper of wisdom to a facilitator among information gatherers. First she had to acknowledge that some of her students were more computer literate than she was and learn to rely on them. Second she had to acknowledge that there was a lot more information in "cyberspace" than she could put a fence around, and that her students could access

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Changes Underlying Educational Reform and Technological Utilization

	Instruction	Construction
Classroom Activity	Teacher-Centered Didactic	Learner-Centered Interactive
Teacher Role	Fact Teller Always Expert	Collaborator Sometimes Learner
Student Role	Listener Always Learner	Collaborator Sometimes Expert
Instructional Emphasis	Facts Memorization	Relationships Inquiry and Invention
Concept of Knowledge	Accumulation of Facts	Transformation of Facts
Demonstration of Success	Quantity	Quality
Assessment	Norm-Referenced Multiple-Choice Items	Criterion-Referenced Portfolios and Performances
Technology Use	Drill and Practice	Communication, Collaboration, Information Access, Expression

(Dwyer, 1994)

this information without her. Third, she had to redefine her role to encourage her students to explore, guiding them to find productive pathways, and helping them analyze and understand what they discovered.

When a classroom is restructured to harness the potential contributions of technology, whole-group, lecture-style, "sit and get" instruction can yield to small-group, learner-centered, cooperative learning. Teachers can move from being "sages on the stage" to "guides by their side," becoming managers and facilitators who can spend more time engaged in creative, individualized instruction. Terms like "coach," "guide," "organizer," "initiator," "diagnostician," and the like appear frequently in literature describing the technology-oriented teacher's new role (Hannafin and Savenye, 1994).

Granted, a growing number of teachers follow this philosophy with or without computers. Others may discover that once they start experimenting with computer-aided EE, they may find it difficult to stay strictly with old models of instruction. A recent industry-funded study involving dozens of teachers and hundreds of students, representing a cross section of America's K-12 schools, found that their technologically integrated classroom:

- encourages fundamentally different forms of interactions among students and between students and teachers;
- engages students systematically in higher-order cognitive tasks;
- prompts teachers to question old assumptions about instruction and learning (Dwyer, 1994).

The greatest student advances occurred in classes where teachers combined technology with what we know to be the essence of effective EE. These classrooms achieved a balance between the appropriate use of direct instructional strategies and collaborative, inquiry-driven knowledge-construction strategies. Students were seen as learners and as expert resources. Students were challenged by problems that were complex and open-ended. In assessing students' work, teachers looked for evidence of deeper understanding—statements of relationships, synthesis, and generalization of ideas to new domains.

The latest educational reform efforts promoting interactive learning environments often point to the critical role of technology (Pearlman, 1992). In addition, new technologies can serve as catalysts for educational reform, guiding teachers and educational institutions toward what has been labeled the "constructivist" view (Duffy and Jonassen, 1992; Yeager, 1991). This constructivist view is in many ways highly consistent with the well-established Guiding Principles of Environmental Education (UNESCO, 1978) and levels of environmental literacy (Hungerford, Peyton and Wilke, 1980).

Technology also can shatter the boundaries of what we label "school." With the aid of on-line learning networks, the learning environment (or "school") can explore new dimensions and places. Students are able to communicate and interact with peers and experts in other states and nations, without leaving their "classrooms." Computer networking broadens the dimensions of school from a four-walled building to the "global electronic village."

Technology Integration and Synergy

While each new technology offers significant teaching and learning opportunities, weaving together a variety of technologies can show teachers and students that the whole is greater than the sum of its parts. When used in combination, computer-aided tools including environmental monitoring devices, video cameras, audio conferencing speakers, databases and spreadsheets, electronic mail networks, and fax machines can create a powerful and exciting learning environment. Ideally a classroom, school, or educational center would have a "technological toolbox" or "learning center" from which teachers and students choose the appropriate combination of tools to match their educational objectives and learning environments. (See page 45 for a sample technological learning center.)

Consider, for example, the following utilization of a suite of technological tools where a pair of middle-school classrooms participate in a computer-aided environmental education experience related to wetlands. While in this example the tools are listed in a particular order, the process would more likely consist of cycles and interactive patterns of technological utilization. Some adaptations would need to be made to accommodate age levels and availability of technologies.

In the classroom...

- Students view an interactive videodisc on wetlands to learn basic background, explore interrelationships and issues, and develop questions for further investigation and research.
- Students access on-line Gopher or World Wide Web sites to see information or images available on wetlands in their area and around the world.

In the field...

- Students use palm-sized digital measurement and monitoring tools to collect data on a local wetland, such as water quality and temperature, which are fed directly into a more powerful computer for statistical analysis.
- Students record direct observations into a spreadsheet on a portable computer for immediate analysis. Charts and graphs can be generated.
- Students use a word processor to write up their observations and data analysis.
- Students use a video camera and capture a visual inventory of their local wetland and pictures of themselves learning about this environment. They mail a copy of the videotape to their partner classroom (across the nation or in another country).

Additional Tools for Computer-Aided Education

All of the developments in computer-aided education will not be covered here. We have not, for example, directly addressed the utilization of some of the fundamental computer tools such as spreadsheets, databases, and measurement and monitoring devices.

- Spreadsheets and databases provide a powerful system for students to organize and query their data. Numerous curriculum guides and workbooks offer activities for utilizing spreadsheets and databases. One that may be especially helpful to environmental educators is the "Computer-Integrated Inservice Notebook: Secondary Science" (published by the International Society for Technology in Education, University of Oregon, 1787 Agate St., Eugene, OR 97403-9905).

- Microcomputer-based measurement and monitoring devices are valuable tools for collecting and analyzing data in the lab and in the field. With a laptop computer and a set of monitoring devices, students can do extensive field-based data gathering and analysis. They can record and graph their data right on the spot. More in-depth analysis and descriptions can occur back at the school site. This can be an extremely engaging and effective way to use simple microprocessor technology and is an example of an authentic-based task. Miniature, inexpensive data loggers are now available for temperature, relative humidity, light intensity, pressure, and voltage. (Onset Instruments, P.O. Box 3450, Pocasset, MA 02559 Phone: (508) 563-9000)

- In addition, this unit does not address the rapidly unfolding utilization of the Geographic Information Systems (GIS) and how it can be used to enhance EE. The exploding availability of scientific images as well as the increasing storage and processing capabilities of computers allow for far greater utilization of this information than has been true in the recent past. Educators interested in this area may want to keep in touch with geographers and planners working in local resource agencies who may use GIS and be willing to demonstrate it to students.

Back in the classroom...

- After viewing the tape of their partner classroom's wetland, the whole class telephones their partner classroom and uses an audio conferencing speaker phone to ask and respond to a series of agreed-upon initial questions about their wetland. (More affordable video conferencing is soon to come.)

- Students choose an "electronic penpal" and follow up the audio (or video) conference by sharing data, asking questions, and comparing/contrasting their wetlands via e-mail.

- Students create a multimedia presentation with graphics, video footage, digital photographs, music, and text which they use to accompany their talks to parent groups, local business groups, and policy makers.

- Students send a fax to their national representatives and media sources outlining their discoveries and recommendations (some students might send e-mail to the White House!).

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Explore the Role of Technology in EE—Start a Local Discussion Group!

Environmental educators and trainers who would like to begin exploring the role of technology in EE might want start a local discussion group. One forum that might help is a guided seminar called "Tapping the Power of Today's Technology," offered through the University of Connecticut and *Technology and Learning* magazine. You organize a group of three or more colleagues in your own center, school, or district, choosing meeting times and locations. The group must meet for five two-hour sessions over a five-month period. Materials, including subscriptions to *Technology and Learning* for each participant, are provided. Group leaders receive a leader's guide with suggestions for activities and discussion questions.

- For more information, write

  Technology and Learning
  Professional Development Institute
  330 Progress Road
  Dayton, OH

Introducing New Tools for Teaching EE

While good teaching has long been characterized by individualized instruction, standbys such as standardized tests, the chalkboard, films, and videos have provided few opportunities for matching the educational experience to the needs of individual learners. Think of new technologies as potentially faster, easier, and sometimes more accessible ways of using proven teaching methods.

It's very time-consuming just to stay abreast of educational-technology developments, let alone carefully experiment with and assess the potential application of these technologies. Teachers will need ongoing training (beyond one-shot programs) and we all must be cautious, patient, flexible, and open to change when teaching and learning with new technologies.

The pages ahead will explore the implications of two "new tools" that deserve our serious attention — interactive multimedia and on-line learning. For those of you just entering technoland, don't worry, the basic definitions and uses of the full array of computer-aided education tools are covered under "Computer Basics" on page 52.

In the technologically integrated classroom, environmental educators can use computers to tap into a pool of information from National Geographic film footage to data on ozone depletion — instantly. In the school or education center, materials may be stored on a central computer or on computer diskettes, CD-ROM, or laserdiscs. Remote materials may be accessed via local electronic bulletin boards or international computer networks such as the Internet. In the near future, access to environmental resources will explode with the availability of fiber-optic pathways or wireless digital satellite transmission. Served to students on their computer screens in the classroom, in the field, or at home, these colorful visuals, dynamic presentations, and encyclopedic environmental resources can stimulate sustained exploration of environmental content, problem-solving skills, and citizen action.

Workshop Activities

The Case of Computer-Aided Environmental Education

In several places throughout this document, suggestions or activities for workshops with teachers are described. Please feel free to adapt them for your training situation.

Make time early in the agenda to engage participants in a debate about the merits and pitfalls of computer-aided environmental education. Ask half of the workshop participants to present the advantages of using educational technology to meet the goals of EE and the other half to present disadvantages. After a rebuttal and discussion period, ask each member to vote by secret ballot for or against using computer for EE, and to list the primary factors influencing their vote. You might consider keeping the votes private and having participants return to their ballot at the end of the workshop to review their vote and reasons for their decision to see if they've now been refined or changed. The handouts "Problems in Perspective" and "Promises in Perspective" in Section IV, may be helpful in your summary discussions.

Computer Language Lesson

Distribute a copy of the Glossary (pages 65-72) to your workshop participants and then divide into teams. Challenge each team to come up with a meaningful sentence of which at least half of the words are from the glossary, with the objective of stumping the other teams' ability to accurately explain what the sentence means. Points are awarded to teams that correctly decipher the most sentences.

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Interactive Multimedia

11

YOU MAY HEAR IT CALLED "new media," "hypermedia," "integrated media," or more commonly "interactive multimedia," but whatever you call it, it's the next giant step in classroom technology and potentially a powerful tool for environmental education. The term "interactive multimedia" covers a lot of territory. "Interactive" means that this new tool offers multiple choices or scenarios, and as the program unfolds, the viewer chooses which sequences or subjects to explore. The presentation "interacts" with the viewer by responding to these choices. "Multimedia" means graphics, music, sound effects, voice, video, and animation, in any combination, in the same program or presentation. These various media are the building blocks of a multimedia product or presentation, but the cornerstone is the student's ability to interact spontaneously with the information or images by using the computer.

Beyond assembling pieces in an electronic version of cut-and-paste, multimedia tools can provide tremendous stimulation and resources for development of critical thinking and problem solving skills.

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Where the Action Is

Keep in mind that many multimedia products are nothing more than electronic books or glorified page-turners. Instead of presenting kids with simple words and numbers, we've added pictures and sound. They can be slow and boring. The value of this technology only comes when we empower the student to take a more proactive role in the acquisition and analysis of information.

Interactivity, therefore, is the potential of this medium that distinguishes it from earlier instructional technology innovations such as slides, film, and video. Where interaction formerly was limited to "off" and "on," multimedia may provide a "hook" to help transform students from passive recipients of information to active participants in their own learning process. The dynamic, media-rich environment provides a potent way to reach students, laying the pathway for truly investigative learning.

At its simplest, multimedia can mean programming one computer to play selected portions of compact discs or laserdiscs on a classroom television monitor or projection device for the whole class to view. However, for the full-scale multimedia experience, environmental educators can turn to a growing field of interdisciplinary programs that can be adapted to many different settings. These programs may incorporate interactive audio and video from a laser disc (sometimes called a videodisc), digital audio or video clips stored on a hard drive or CD, or video footage from a now-conventional videocassette recorder.

Environmental Multimedia

Environmental multimedia offers the potential for true "whole systems learning"— mirroring the whole systems of mind and the planet. The flexibility and multidimensional nature of these new media can parallel what we know about research on learning style — Gardner's Theory on Multiple Intelligences (1985), McCarthy's 4-Mat process (1981), for example—where we find students learn best in the style suited to them. Multimedia also can model and mimic interactive, complex behavior of natural and human systems. Environmental multimedia is therefore a dynamic, flexible tool—promoting dynamic, interactive learning in a dynamic, interactive world. Environmental multimedia can mirror the way we learn and the way the world works.

Do Your Own Thing

If the formats of existing products do not meet your specific needs, then "multimedia authoring tools" can be used to "mix and match" elements of these products to personalize your multimedia presentation. Using these resources and other materials of their choice, teachers and students can research, write, and assemble their own multimedia presentations or reports, complete with video, sound, text, and illustrations.

If you don't find all the media elements you need from commercial products, you can create your own multimedia products. For several years, teachers and students have been able to create their own laserdiscs; recent breakthroughs now allow users to master (or "press") their own audio, visual, or data CDs.

Storage Power!

Because CDs and laserdiscs store tremendous amounts of pictorial, audio, and text information, they are particularly well-suited for encyclopedic reference materials. A CD-ROM (compact disc read-only memory), for example, can store the information equivalent of 350,000 pages of text — 450 times the data of a conventional floppy disk. Just one side of a typical laserdisc can store the information equivalent of 52,000 slide images or 5,000 floppy disks. New data compression will radically increase this storage power in the near future. And remember, this information can be stored as sound, animation, video footage, graphics, or text and any piece of it can be accessed almost instantly.

CD-ROM is likely to be the fastest growing product in the next few years. Even though there is still a relatively limited base of installed CD-ROM drives, many developers are convinced that the expansion of CD-ROM drives into the consumer marketplace is likely to follow the same path as VCRs in the late '80s. One reason for the growing interest is the advent of new technology that allows video to be displayed directly on the computer screen, avoiding the need for an additional video monitor.

CD-ROM vs. Laserdisc Multimedia

Laserdiscs and CD-ROM offer very different strengths. CD-ROMs were conceived as storage media, and can be used to store just about any data, including text, numbers, audio, images, and video. They store data in a ***digital*** format. Laserdiscs were conceived as a storage medium principally for motion video, images, and audio, and use ***analog*** encoding. Perhaps the biggest limitation of laserdiscs is that their analog data cannot be shared over a local area computer network (LAN), which "speaks" digitally.

Ten Reasons to Use Multimedia

PC World magazine (October 1993) outlined "Ten Reasons to Use Multimedia in Education." While in many cases unproven and overstated, they also underscore the potential of multimedia in education.

Multimedia is:

fast — learning speed accelerates.

cheap — the program never asks for a raise; the more you use it, the less it costs per use.

consistent — no mood swings, yawns, or lapses.

private — ask what you want; no one will laugh, no one will scold.

safe — experience nuclear meltdowns without fallout; experience drunk driving accidents or electrocution without blackouts or death.

personal — it never tires of praising and motivating through positive feedback, any time, day or night.

a strong foundation — on which to build mastery.

a tool to make remembering longer, easier — many parts of the brain are stimulated.

more information faster — on things a school couldn't afford to teach: like space-shuttle repair, brain surgery, black hole sailing.

fun — like a game: yes, like Nintendo, which, with a joystick and a screen, has already captured the brains and fingers of an entire generation.

Today, some of the most exciting EE multimedia combine the best of both storage media, utilizing CD-ROM to store software which accesses motion footage and sound stored on a laserdisc. While the future of compression technology and storage media is highly uncertain, for the foreseeable future, schools interested in multimedia should purchase both laserdisc players and CD-ROM drives.

For a list of publications which cover the latest CD-ROM, multimedia, and other computer-aided environmental education products, see "Environmental Education Software and Multimedia Catalogs" on page 58.

Why Bother?

Interactive multimedia is being aggressively funded by many school districts, and many museums, zoos, aquariums, and other education centers are following their lead. For example, the Lee County Public School System plans to buy 4,000 personal computers and has set aside $35 million for educational technology, especially the purchase of multimedia material. In North Carolina, the Department of Public Instruction is requesting $356 million over 10 years to provide schools with upgraded technology, including CD-ROM drives and other multimedia hardware. Texas was the first state to adopt multimedia software as a textbook substitute. Given the costs of technology, the need for additional training, and the cost of multimedia products, you may be asking yourself, "Why do these educators bother with this new teaching tool?"

Reasons to Use Multimedia in Education

Definitive research on the positive impacts of multimedia in education has not yet been assembled. While many would argue that the jury is still out, here are some important reasons to utilize this technological tool in EE:

- It facilitates student-centered learning allowing choice in the pathways for learning and the rate at which new material is introduced.
- It can address several learning styles and modalities – providing a rich variety of instructional approaches which can teach in most of the ways that students learn best.
- It motivates student interaction, experimentation, and cooperative learning. Students often work together on computer projects as they never did on paper-and-pencil projects.
- It facilitates "storylines" or thematic learning – where a pathway for exploration can easily be woven around a particular concept or context, such as ecosystems, environmental restoration, or population dynamics.
- It promotes the "constructivist" view of learning.

But How Can We Really Use This Stuff?

Now that we've addressed the "what and why" of interactive multimedia, let's turn our attention to the "how." While environmental educators already have numerous ways to use these new tools, the interactive multimedia teaching and learning frontier is wide open ... and the technical horizon continues to rapidly unfold.

There are five principal ways multimedia technology is used in EE today:

1. at the front of the classroom as a more flexible and versatile update of traditional audio visual media used in lecture/presentation;
2. in student groups for collaborative learning;
3. in individual student use for independent learning;
4. in the creation of reports or presentations; and
5. in assessment.

Lecture/Presentation

Connect a single computer to a projection device and you have a powerful tool providing audiovisual support to emphasize lecture points. The instructor can incorporate printed barcodes (similar to UPC codes on retail packaging) into lecture notes, then use a barcode scanner to activate recorded images and sounds at appropriate times.

Interactive multimedia can create compelling classroom audio visual demonstrations. The teacher can pause at critical points, show entire sequences of a video presentation in slow motion and review important concepts quickly and easily, then pull in a computer-generated map with today's data, and then skip to...

Collaborative Learning

Utilized as a learning station in a classroom, interactive multimedia enables small groups to share their expertise and to explore in the learning process together. Teachers can facilitate the learning process and guide learners down pathways, working in a collaborative process. Thus, specialized training is not limited by the knowledge of instructors, the availability of scarce or valuable teaching materials, or the availability of teachers.

Individualized Learning

Educational presentations on the computer provide a private, non-judgmental learning environment: The student controls the pace in a "hands-on" learning experience and can back up, repeat a segment, or ask for further explanation. For quick learners, multimedia allows the opportunity to explore beyond the basics of the course. For slower learners, individualized learning situations lessen the fear of having to publicly ask for extra help or admit that they "didn't get it" the first time around.

Students who have missed class, or who need to review, can study audio/visual supported lectures and demonstrations independently.

Creating Reports or Presentations

Students enjoy developing their own multimedia products. With authoring programs students can prepare a variety of audio visual reports. Computerized slide shows are simple; for extra pizazz try a "video term paper" with complementary moving footage, charts, pictures, and music.

An authoring system connected to a laserdisc or CD-ROM player simplifies the task of producing and editing videotapes. Cues, cuts, captions, and other editing chores can be preprogrammed from an assortment of different discs to create smooth, professional videotapes. Teacher-compiled material can also be transferred from high-quality master tapes directly to custom-made laserdiscs for classroom use.

In an increasing number of schools, teachers are combining an authoring system, laserdisc or CD-ROM player, computer, word processor, and graphics software in a state-of-the-art curriculum development workstation. The materials they are developing range from simple handouts and overhead transparencies to student workbooks and even complete course textbooks. (See page 45 for a sample technology learning center.)

It is important to note here, however, that most studies of introducing computer-based technology in the classroom say time for teachers to learn to use and then to apply such technology is a critical but often missing element in achieving success. Your workshops and follow-up support could make the difference for many teachers.

Assessment

In a group testing environment, the teacher might call up a frame illustrating various environmental problems from a disc and ask the students to identify potential solutions. For individual testing, the students can take entire exams at a computer connected to a laserdisc or CD-ROM. Answers to audio/visual-supported multiple choice, true/false, or fill-in-the-blank questions are entered into the computer, recorded and graded instantly. The power of this technology lends itself to more sophisticated testing procedures and various aspects of "authentic assessment" — taking assessment beyond mere record-keeping. Computer technology puts feedback on progress within reach of each learner, and provides powerful tools for building student portfolios.

The ability of multimedia to present material, ask questions, and respond according to the student responses, opens up an exciting new venue for educational media: interactive lessons and activities. Teachers already are creating activities where students are shown, for example, insects and asked to identify shared characteristics. The teacher programs the system to ask more probing questions, based on individual student response.

. . . *Other Ways?*

Are our current uses of computer technology in EE unnecessarily confined by our limited experience? Are our applications "boxed in" by how we have taught in the past and how we have utilized educational technologies of the past? For the future, we may need to "get out of the frame in order to clearly see the picture." Our challenge in the years ahead is to not let historical patterns and experience limit our creative application of new educational technologies in EE.

In John Naisbitt's "Megatrends" (1982), new technologies pass through three stages. In the first stage, the new technology follows the "line of least resistance," into a ready market. At the second stage, users improve or replace previous technologies with new technologies. Finally, in the third stage, users discover new functions for the technology, based on its potentials.

In the third stage, educators using technology bring about a paradigm shift. They don't just squeeze technological tools between the existing bricks of yesterday's educational practices. They ask, "What can we do now that was not possible before? How can these new tools contribute to a more powerful educational experience?" As environmental educators, we are just entering this third stage.

Training Tips and Techniques

It's very difficult to verbally explain interactive multimedia. It's unlike anything you've experienced before. There are no adequate analogies. You have to see it demonstrated and you have to try it yourself to really get a clear sense of this medium. This poses significant technical and logistical requirements for an effective training workshop.

Technical Considerations

- You'll need a speedy computer with eight or more megabytes of RAM and a compatible CD-ROM drive and/or laserdisc player. The computer may also need a big chunk (several megabytes) of available hard drive space and the software necessary to run the multimedia products you are presenting.
- If you are demonstrating a laserdisc, you will also need a color monitor (basically just a color TV) to run the video footage. Digital video on a CD-ROM should run directly on the computer screen, so no additional monitor is necessary.
- Unless you are training a very small group that can crowd around your computer screen and monitor, you will also need a way to project your screen so that everyone can see. A color liquid crystal display (an LCD plate) and an overhead projector work just fine. An alternative is a new piece of technology where you plug your computer into one end and a monitor/TV into the other, and your monitor/TV now shows what appears on the computer screen. This same hardware can be plugged into a VCR so you can tape exactly what is appearing on your computer screen! New projection and presentation technologies are always hitting the market.

You can see that the easiest way to do a workshop is in a computer lab or training center. Many school districts and universities, as well as some libraries, already have all of this technology, fully integrated and compatible — ready to go. It will save you hours of time and oodles of money if you can bring your participants to a facility where the technology is already available, as opposed to bringing the technology to them.

If you can get access to a computer lab or training center, go there well in advance of your presentation and "crash test" the products you will be demonstrating. Try in advance ***everything*** you plan to do in your workshop to be sure that things won't grind to a screeching halt because of "technical difficulties beyond your control."

If you are responsible for providing equipment and setup, do your legwork well in advance. It almost always is more time-consuming and complicated than you expect, and something often goes wrong, so plan ahead.

Logistical Considerations

- Arrange the training so that the workshop participants can see the computer monitor or projection screen, and so that the trainer looks at the class. This way you can monitor and respond to looks of delight or confusion as well as participants' questions. It may be helpful to enlist one or more participants to operate the computer keyboard according to your directions.
- Briefly state the goals of the training and the specific objectives you plan to address. Poll your teachers to see which have experience with interactive multimedia and which do not. Encourage them to share their frustrations and their success stories.
- At the beginning of the workshop, find out what participants want to know, then respond directly to their needs by weaving in specific examples, products, or techniques. It's ideal to actually do this with a pre-workshop questionnaire.
- Consider pairing or grouping more experienced and energetic participants with those who are new to or pensive about computer technology.
- Strive to show the variety, both in form and content, of multimedia resources. Demonstrate the unique capabilities of both CD-ROM and laserdiscs. Show them the tools of today, but be sure to mix in some of the possibilities of tomorrow.
- Show specific examples of how interactive multimedia resources can be used for lecture/presentation, collaborative learning, individualized learning, creating reports or presentations, and assessment.
- Remember that your participants will have little if any previous experience with this new medium (unlike other traditional teaching tools). Share with them lots of stories about how other educators are using technology, but also remind them that they are participating in a unfolding process.
- Emphasize how this technology is only a tool to enhance what they are already doing and that it is not just another thing they should add to their over-crowded curriculum.
- Be sure to allow time for small teams of 2-5 teachers to explore together. While demonstration to large groups is fine, to fully experience the dynamic of cooperative, self-directed, interactive learning that this technology allows, a small group is a must. Give participants plenty of time to have direct, hands-on experience with the technology.
- You may wish to duplicate pages 54 to 64 to provide a list of EE-related computer products and resources.
- The *Workshop Resource Manual* unit, "Designing Effective Workshops," offers tips for facilitating discussions, organizing small groups, and developing an appropriate agenda for workshops.

Workshop Activities

Consumer Testing Multimedia

Once teachers are sold on multimedia, they'll want to purchase software for their school. Here is an idea for engaging workshop participants in a discussion about their criteria: Set up stations where participants test software or multimedia programs that you have available, and ask them to write a catalog-like description for this item. Then compare their versions with the real sales pitch and lead a discussion that will help participants become savvy multimedia consumers. What are companies likely to emphasize? How well does this coincide with what teachers need to know?

Create a Multimedia Teaching/Learning Station

Give each teacher team a catalog from an educational technology catalog selling hardware and software, a $5,000-$10,000 budget, and the job of creating a multimedia teaching and learning station that could roll around in a typical classroom. Have teams report their expenditures for hardware and software and describe at least three activities students could do at the station. The most creative spenders can keep the catalogs! Pick up a few copies of a newsstand computer magazine, or contact your local computer store or reference librarian to obtain copies of current prices for hardware and basic software.

The resources listed in Section V, on pages 51 to 64 may be helpful for each of these activities.

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On-Line Learning

III

IT'S BIG, IT'S FAST, IT'S HIGH-TECH, but is it good for EE? The headlines tell us the "global Internet" is expanding faster than a supernova, already reaching millions of computer users around the planet and growing by 10 percent or more per month. Won't yet another tantalizing technology separate us further from experiential learning about our place on the planet?

Maybe. But like any educational technology, how telecommunication is used in communities and classrooms will determine whether it is valuable or distracting, a tool of empowerment or a toy for passive entertainment.

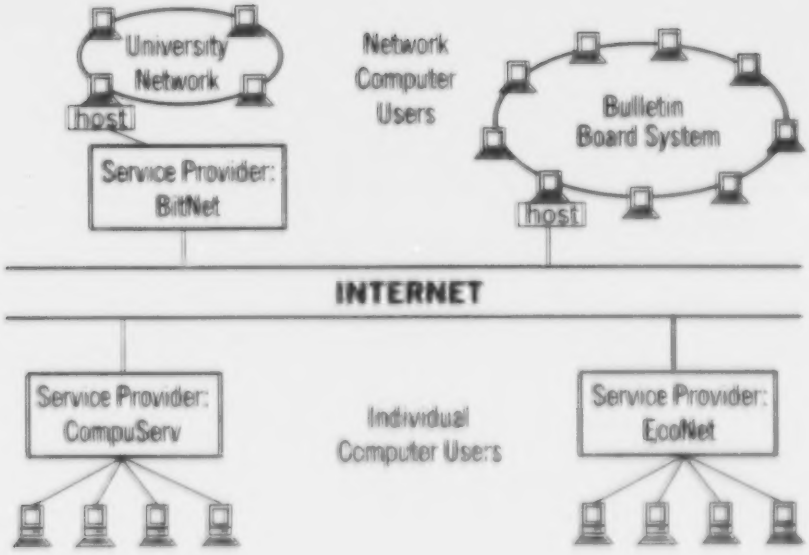
Fundamental to thinking about on-line learning is thinking about our relationship to the process; the technology itself comes without a value system. Computer telecommunications simply provides access to information and opportunities for interaction. Used properly, it can enhance educational experience and provide a venue for collaborative action to solve environmental problems.

Some Examples of On-line Learning Projects:

- Students measure water quality of a local river and exchange data electronically with peers throughout their watershed to assess the health of their ecosystem, through GREEN, the Global Rivers Environmental Education Network.
- Students become delegates negotiating an international treaty on the development of Antarctica with the University of Alabama's Project IDEALS.
- Teachers and students "participate" in a scientific expedition to Belize with the Jason Project expedition, thanks to computer networks.
- Weather reports are available for any location in the United States and students can input their own data through the University of Michigan program "Blue Skies."

More descriptions of similar projects begin on page 36.

The Internet



What Is On-Line Learning?

Sending electronic messages, images, and sounds over phone wires or via satellite, tapping vast stores of text and data: these are the basic elements of telecommunication. But we can't say that computer networking contributes to learning about humankind's relationship with the biosphere until on-line access to information and to each other increases individual knowledge, improves comprehension of life and natural processes, and engenders in individuals the ability to act, or refrain from acting, responsibly on the planet.

The scientific and academic communities pioneered computer networking in environmental studies. Pilot projects have scientists, teachers, and high school students sharing field research about environmental quality. Computer telecommunication lets them leap former boundaries — whether in one watershed or around the planet.

Elementary and secondary school learners share their life experiences and visions of the future also by sharing information on-line, either with private messages or through public conferences. Their messages to one another, delivered with tremendous speed and shared simultaneously among many classrooms, provide strong, personal lessons in the interconnectedness of science, geography, and human relations.

By reducing the barriers of travel, cost, and time, computer networks allow environmental professionals and teachers to develop extensive on-line communities of peers, and to become active co-learners in the education process.

Using the personal computer's ability to communicate over standard phone lines with a modem, the simplest networks act as "store-and-forward" systems that echo messages from one computer to the next, until all have copies. These clusters of computers generally connect to bigger clusters of computers, linked by high-speed data lines and satellites that exchange information with one another in split seconds, and provide access to millions of people, vast stores of information, and tremendous computational power. The Internet is this network of existing computers, mainframes, and phone lines.

First, there are the small networks. These may be community bulletin board systems, office or school computer networks. Many of them can pass messages, called "electronic mail," back and forth with one another.

The Measure of a Teacher's Internet Skill

The best measure of a teacher's skill may be how the teacher **does not** use the Internet. If teachers spend most of their time looking for the "pot of gold" that they are convinced is out there, then they are perpetuating the view of the teacher's role as giving "answers" to students.

On the other hand, if teachers spend most of their Internet time sharing/collaborating with others, and creating resources (making available students' work and their own ideas), then I would rate that teacher's use as very skillful. They recognize that the teacher's role is helping students collect data, use data, make sense of data, communicate their findings, and revise based on others' input.

— Alan Feldman, TERC (Written in COSNDISC, March 8, 1994)

Somewhat larger networks connect many of the smaller networks together. Thus we have "Bitnet," which connects many academic institutions; FidoNet and OneNet, voluntary associations of local bulletin board systems that share electronic mail and conferences with one another; non-commercial networks such as EcoNet; or commercial networks like Prodigy, America On-line, and CompuServe. Many of them also share information resources and electronic messages across the high-speed network of high-performance computers used for research, education, and commerce, initially funded by the National Science Foundation but now open to private enterprise, known as the Internet, with a capital "I."

Because they adhere to public standards for information exchange, all of these small to large-sized networks are or could be interconnected. Common standards are what define the Internet, and the very fact that the standards are public has acted as a catalyst for the Internet's phenomenal growth. Internet standard "protocols" have acronyms like **TCP/IP**, **FTP**, telnet, Gopher, **WAIS**, and **WWW**. Some of these are discussed later in this chapter; they are also included in the "Glossary of Computing Terms."

Within and across the computer networks are "human networks," formal and informal associations of people who communicate regularly using on-line services. Each of these groups shares common interests or goals, and is effectively a "virtual community" or subculture on the computer networks.

This vast new world of opportunity presents many challenges. The enormous glut of information is impossible to take in and has forced those who would taste its power to devise new ways for organizing and sampling the information flow.

Electronic mail services and computer "conferencing" let students, teachers, parents, professionals, and policy makers communicate with each other privately or publicly as members of discussion groups.

Electronic mail allows private one-to-one or one-to-many exchange of messages that can include text and "attachments" such as graphic images, spreadsheets, and computer programs. Standard address formats and transmission protocols allow messages to be exchanged across different physical computer networks throughout the world — often in only seconds.

Computer conferences transcend time zones, allowing participants to review and comment on each others' written postings as their time and interest allows. They also transcend many cultural barriers. Organized much like conferences where people meet face to face, these meetings take place inside each participant's computer. Everyone gets to read and think about questions or statements posed in an on-line conference, and everyone has an equal opportunity to reply. While this electronic conferencing abounds with opportunity, it also challenges

Workshop Activities

The Language and Tools of Telecommunication

Modem, baud rate, upload, telnet, Gopher, system this and system that: The language of telecommunication, while a subset of English, is bewildering.

One way around the language barrier is to treat every computer network workshop as a foreign language lesson. Identify the vocabulary that will be used before the training session begins, and make sure it's OK for anyone to question the meaning of any technical term.

In most audiences or classrooms in the United States, nearly everyone will be able to offer a few words in computerspeak, along with the meanings that ascribe to them. As an ice-breaking exercise, ask for examples of computer terms that could be replaced by simpler, plain-English words. The glossary included in Section V can help to overcome translation problems.

participants to discriminate fact from fiction and to evaluate opinions – without being able to look the other folks in the eye.

Access to electronic databases has extended huge indexes of reference material – like never-ending card catalogs – right into the classroom, home, and workplace.

Computer networking is blurring the distinction between "education" and "real life." Environmental issues are entering the classroom with immediacy via computer networks, and students are jointly seeking understanding and solutions with scientists, citizen activists, journalists, government officials, and community leaders of all kinds. The opportunities for continued learning among inservice professionals are expanding as well.

What On-Line Learning Is Not

If the Internet is an information highway, as it's been called, it's not nearly finished yet. New sections are being added every day, and there are serious problems with potholes, detours, and traffic congestion. Add to that the fact that not everybody has or even can afford a vehicle to travel the information highway, there are few good roadmaps, virtually no driver training, and not enough service stations to keep you rolling. It's past the Conestoga wagon era, but not much.

The Internet is not better than face-to-face meetings, books and periodicals, or even television. It is not particularly easy to learn to use, and you may have no luck finding the information or the people you seek once you learn to use it.

Why Even Attempt It?

Despite the challenges, there are some proven and potential reasons for using computer networks in EE:

- Computer networks have been shown to be useful educational tools.
- Computer networks can foster new, empowered electronic communities able to cope with complex environmental issues.
- Computer networks can provide a way of obtaining and disseminating information that has tremendous advantages over other media.
- The world is increasingly networked via computer, and use of computer networks is becoming a requisite skill in commerce and government. Computer networks are not going away. Teachers and teacher educators need to learn to work on-line to keep up.

– Success is possible using computer networks for EE, but knowing how to succeed involves more than simply learning how to use a computer and e-mail.

Telecommunications Hardware and Software

The tools of on-line learning come in two basic forms. If you can touch it, it's hardware. If it provides instructions for the hardware, or information for you the user, it's software. Generally, the software "lives in" or is contained by hardware. A "floppy disk" is hardware that contains recorded programs or data, which are software. To use a computer to communicate, you need both hardware and software.

First, you need a computer. The computer must be capable of performing serial data communication — sending and receiving digital information, usually over a wire. Some computers are faster, but even an old Apple or Commodore computer, common in elementary school classrooms, can be used to communicate.

Any computer needs telecommunication software to tell it how to communicate. Generally, any communication software that works with your computer will do, but better software makes the task of communicating much easier. The easiest communication software requires the least memorization by the user; some simply requires pointing at graphical pictures to accomplish communication tasks. Still, it is usually easier for anyone to use the software they are most familiar with than to learn how to use a new software package. A key thing to learn about your telecommunication software is how to set its communication parameters. Settings in your software must match those required by any on-line service you use. (Luckily, most of them are nearly the same.)

A modem is a hardware device, attached inside the computer or connected to the outside of a computer via a plastic-coated set of wires called a cable. A modem turns digital signals into sounds, so they can be transmitted over standard telephone lines. Generally, you'll have a happier time using computer networks the faster your modem is. An older, slower modem (1200 baud) will do fine for simple text message exchange when a newer one isn't available, but the latest interactive on-line graphic services require high-speed modems (9600 baud or faster). Modem speed is counted in bits per second. (It requires eight bits — eight bits are a byte — to make a single alphanumeric character on your screen.) Modems capable of sending and receiving 14,400 bits per second now are inexpensive ($100-$150), and modems twice as fast are available at lower and lower prices each month.

Unless you are directly connected to a computer network you also will need a phone line. Telecomputing does not require a dedicated phone line, though if somebody picks up an extension and dials while your computer is using the same line, your messages may be garbled. You may also need to learn to turn off "call waiting" or other special features. (Your local phone company can tell you how.)

Choosing A Service Provider

For you to communicate using your computer, communication software, and modem, you need another computer at the other end of the line. This remote computer is known as your host or service provider. At the simplest level, a remote host may be a computer in an office or classroom across town. It may be a local bulletin board system (BBS), or it may be a computer service connected to the Internet, via which you can interact with many other host systems and their users.

Internet Services

Full-service Internet providers offer an array of services, including the following. The provider you choose should be able to provide a mix of services that meets your needs. A list of network service providers is included on page 59.

Internet E-Mail: The ability to exchange electronic mail with anyone who has an Internet address is a fundamental feature. The ability to keep group or personal mailing lists is a nice additional feature. An Internet address consists of the user's account name or identifier, separated by an @ symbol from the "host name" of the network service provider. Here are two examples: aalm@igc.apc.org and rocky.rohwedder@sonoma.edu.

Gopher: The Internet Gopher lets you browse for resources anywhere on the Internet using menus. It's an easy way to "go fer" information (bad gopher humor; it actually was named after the mascot at the University of Minnesota, the "Golden Gophers"). Some systems offer graphical Gopher client programs, which provide a "point-and-click" interface. Text-only Gopher is available on many systems via a menu option.

Telnet: Telnet, a feature selected via a menu option on many host systems or via a graphical icon on others, allows you to visit any public or private (if you have been given access) computer on the Internet. There are a number of "sites" on the Internet that are especially valuable for EE. Some interesting telnet sites are included under "Network Service Providers" on page 59.

Usenet-style Newsgroups or Conferences: If on-line conferences are stored in standard formats, they can be shared between multiple computers on the Internet. Thousands of public conferences already are shared this way, many of them a part of the Usenet conference distribution system. Some systems offer text menus for browsing conferences; others provide graphical point-and-click "newsreader" software for your computer. More on conferences can be found under "Network Service Providers."

FTP: The Internet File Transfer Protocol is the fastest way to transfer files between computers on the Internet, and the only way to retrieve some files, like satellite images of the Earth or map data. FTP can be difficult to use, since it requires some knowledge of UNIX commands. But tools like Gopher and WWW (World Wide Web) can make file retrieval via FTP simple.

Internet Relay Chat (IRC): "Chatting" with others by exchanging text messages while simultaneously connected to the Internet is a popular feature on some networks. Interactive audio and video links are available on some high-speed networks.

World Wide Web (WWW): WWW links documents on the Internet as "hypertext," allowing the user to browse from document to document by selecting highlighted links. A link may be a word or a graphical image. On systems that provide graphical WWW client programs like Mosaic, WWW is a visually exciting, point-and-click way of exploring that portion of the Internet that contains "web" documents. Text-only WWW services such as Lynx are available on some networks.

User Support: Good support is a part of telecomputing that can't be left entirely to machines. Having a human to call or e-mail who can answer users' questions is a key element in network services. User manuals, on-line help utilities, and support forums also are important to consider when choosing a network.

For ease of use and convenience, you might want to review the following features.

Graphical User Interface: Using a pointing device such as a computer mouse to select options on a computer network, rather than typing commands at a keyboard, is easier for many network users — especially for hunt-and-peck typists. More and more computer networks are offering this feature.

Off-line Mail and News: Where network connections are expensive and budgets are small, the ability to read and write electronic mail and to participate in on-line conferences while not connected to a network can be a real cost-saver. In schools, this can broaden the availability of networking to students and teachers. Off-line mail readers, provided by some networks, connect to the network only to send or receive mail; all of your reading and writing gets done in your personal computer. News readers, similarly, allow review and responses in on-line conferences to occur in an off-line setting.

Bulletin Board Systems

As of mid-1993, *Boardwatch* magazine estimated that there were some 60,000 computer bulletin board systems in the United States alone, a number that is growing rapidly. The BBS fills the need for special-interest computer communication in a wide range of situations. Because simple bulletin boards are easy to set up and use, and inexpensive to operate, they can provide an ideal setting for training in telecommunication, or for educational communication within an institution, organization, or community. BBS software is available for different computers, at prices reflecting the features offered. This enables most computers with modems and phone lines to become exchange points for electronic mail, file exchange, and on-line dialog. Generally, only larger local BBSs provide full access to the Internet.

In most communities, the local boards are the best avenue for learning about on-line networking. BBSs run by computer-user groups are common, and provide access to local expertise. Inquire at local computer stores or the computer departments of local colleges or universities for local BBS phone numbers. Many bulletin board systems provide comprehensive listings of other BBSs around the country.

Education, Research, and Government Networks

Education, research, and government networks are becoming common in most locales. Typically, these networks provide access to electronic mail and other services for all computer users in a specific category. Many states now provide access for all K-12 educators at low or no cost. Colleges and universities typically provide computer network access for faculty and students. Scientific research institutions were among the pioneers using on-line communication for collaborative research. And government agencies are increasingly using computer networks to share data and to connect experts in a range of environmental specialties both within agencies and across state and federal agency boundaries.

Ease of use and access to Internet services vary on institutional networks, ranging from very limited access to systems that assume you have computer programming knowledge, to high-speed graphical gateways to cyberspace. Check with your local system administrator or educational technology consultant for details.

Commercial and Non-Commercial Networks

Commercial and non-commercial networks serving the general public are accessible from anywhere in the United States, with prices starting at about $10 per month. In addition to the cost of the network service, long-distance telephone access may be an additional cost, particularly from rural areas, although most large network service providers offer local access in urban areas.

Not all material or dialog on the Internet is suitable for education, particularly for young network users. Consider journeys by students onto the Internet to be a "field trip." Many schools and educational organizations are developing policies describing appropriate activities and behavior on the Internet; some are limiting students' access to a subset of the Internet's resources.

These public networks serve specific audiences, some more broadly defined than others. Some offer easy-to-use graphical interfaces, but limit the user's ability to explore the Internet. Others offer text menu systems that may be more difficult to learn, but offer broad options to explore Internet resources. A list of broadly accessible networks that offer access to resources for EE is included in Section V on pages 60-63.

Ways to Use Computer Networks

Glean information

Receive action alerts and timely news

Look up information on other individuals and groups

Search resource lists

Broadcast information

Post time-urgent announcements to broad or selected audiences

Publicize conferences, events, calendar of activities, and services available

Post newsletters or other documents for broad access

Communicate interactively

Ask questions

Dialogue with friends and colleagues

Hone opinions and positions

Work together

Coordinate meetings and plans

Link to other electronic mail and database systems

Make decisions with dispersed members

Plan conferences and follow-up

Publish on-line (newsletters, occasional papers, etc.)

Coordinate a group-authored paper

Also...

Reduce phone expense and eliminate phone tag

Dial locally, act globally

(Adapted from the "Guide to Creative Conferencing," Institute for Global Communications)

Keys to On-Line Success

Using computer networks takes practice. There are few shortcuts, and even most of the main roads are "under construction." Computer networks are relatively new and are experiencing phenomenal growth; there are still a lot of rough edges, and things frequently break under the strain.

So the fundamental lesson in computer networking for EE, whether in a training workshop or integrated into a long-term education strategy, is patience. Painting false expectations of the tremendous resources available on the networks can lead to discouragement among participants, and outright hostility toward the technology, if the way to those resources is too rough. Once frustrated, a would-be networker is less likely to try again.

Some key elements identified for success in building electronic communities are good to keep in mind when considering on-line EE (Riel and Levin, 1990). They are summarized and explained below.

- Use of computer networks must be relatively easy. Users need access to the technical equipment, software, training, and support for sending and receiving messages. They also need the time and social support for such activity. If using a computer network is an added burden in an educator's already overloaded schedule, it won't happen.
- There must be strong incentives for using computer networks. This type of communication must be more efficient or productive than other kinds of research or interaction.
- For a group to function well in an on-line environment, it needs to share specific goals or tasks. There must be clear expectations of the requirements for responding to messages.
- Someone must take responsibility for facilitating on-line interaction.

Ease of Use

How "easy" on-line networking is for the individual user depends on several factors. First, the computer used for networking must be accessible. If telecommunication requires a trip down the hall, or staying up late at night to take advantage of low-cost phone rates, it is less likely that telecommunications will be integrated into the regular routine of an educator or student. So convenience is a key consideration in planning for success in telecomputing.

Second, the simpler the computer hardware, software, and telecommunications service is to use, the likelier it is to be employed. Low-cost equipment, software, and services may look like a bargain, but they can be discouraging.

Incentives

Unless there is a strong perceived need or value in computer networking, people will choose other ways to communicate and to find information. Likewise, disincentives like cost and the time required to use a new technology can block success, if the value of using the technology is unclear. Sometimes, an incentive may be simple: Access to timely information that may not arrive for days or weeks by mail, or the ability to correspond quickly to meet an important deadline, can be great motivators for using computer networks.

"Models For On-Line Projects" is provided as an overhead master on page 50 in Section IV.

Setting Goals, Tasks, and Rules

Without clear strategies for using on-line communication in EE, the technology can easily become a hindrance rather than a help. To make effective use of the technology, whether in a classroom, training session, or in an interactive on-line project, setting goals, measurable objectives, timelines, and rules or expectations are essential.

Goals for on-line communication may be broadly stated, but they should reflect the needs of and purposes for the effort. "We will use computer networks to access information resources that are not available locally," or "This project will use a computer conference to share environmental monitoring data among participants at geographically dispersed sites," are examples of goal statements.

Objectives are more specific. They generally provide the "who, what, and when" for tasks. "By the end of the training, participants will have used gopher and telnet to access a variety of information resources on air pollution," or "Each participant in this project is expected to respond to electronic mail from other project participants within 48 hours," are examples. An objective should be stated so that evaluation of success is straightforward — either it was met or it wasn't. By sharing or even co-developing objectives with a group prior to an activity, all participants can form a common understanding of purpose. This is especially important when they are communicating only via computer networks, without the same group dynamic that develops in face-to-face situations. More about setting objectives for a workshop can be found on page 11 of the *Workshop Resource Manual*, "Designing Effective Workshops."

In offering telecommunication training to groups where the participants have varying knowledge, experience, and aptitude, a self-evaluation checklist of knowledge and skills can enable participants to track their own progress and set their own objectives. An "I Can Telecommunicate" checklist is provided as a handout on page 49 in Section IV.

Rules for on-line interaction are important, largely because the on-line environment differs in many ways from the interpersonal situations we are used to. The phenomenon of "flaming" on computer networks — heated, sometimes intensely personal dialogue or debate that rapidly escalates and eclipses other discussion — demonstrates that some social norms need reinventing in cyberspace. Eye contact or peer reaction that might cause embarrassment for "making a scene" in a face-to-face encounter don't exist on-line. The box on page 30 outlines one group's attempt at a simple set of ground rules for on-line conferencing that can easily be adapted for group electronic mail. An activity suggestion on page 33 allows your workshop participants to discuss potential problems and ways to solve them.

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Ground Rules for On-Line Conferencing from ConflictNet

We are trying something new here, so I am very open to reactions and responses. Electronic conferences have some interesting aspects and I would like to begin to develop some relevant ground rules.

1) I encourage you to make the effort to add a response to the "Sign-in" topic. If you do sign in, we will make the assumption that you are in the room with us and will check in periodically, to read.

2) If you make comments in the discussion we ask that you make a commitment to staying with the conference. Passing comments are disruptive. If you are leaving the conference it would be expected that you would let us know.

3) Be concise. Lengthy postings are difficult to follow. This is "taking too much air time" in a Face to Face (FTF) meeting.

4) Stay on point. If you introduce many varying ideas, it is difficult to track conversations and it is easy to lose ideas.

5) If a relevant topic is available, try to make your responses to that topic.

6) If you are posting a resource rather than a discussion, create a new topic and use RESOURCE: as a header in the title. i.e. RESOURCE: Consensus Guidelines.

7) If there is valuable information in other conferences, post a topic with a title POINTER: good story (or other appropriate words).

There may be more ground rules and I will use this topic to add new rules as needed. I would also encourage you to make comments, add to, or critique this list.

One last request, please sign your postings. We can look up your login in the user directory, but it is preferable to let us know your name and how you wish to be addressed. **Thanks.**

– John Helie in ConflictNet conference <cr.publicpolicy>, Feb. 7, 1994

The Importance of On-Line Facilitation

Imagine a meeting where everyone arrives but finds that no agenda has been set, there is no decision-making process established, and nobody is running the meeting. Compare that with a meeting where the agenda is well developed, there are clear steps for making decisions, and a skilled facilitator helps to keep discussion moving and focused.

The dynamics of on-line activities are very much like face-to-face meetings. How the dialogue starts can easily set a pattern for how it continues. If only a few members of a group contribute, the remainder may forever be passive observers, and no real group-wide discussion occurs. A facilitator can ask questions to clarify, remind participants of unresolved issues, and provide summary and synthesis of a discussion to help it along.

Continuity of Support

How to provide help for the exploding population of computer network users is a tremendous and costly challenge. Fortunately, the medium lends itself to co-support among peers, but this requires attention from every on-line user community to identify and address its own needs.

Mentoring, organized or ad hoc, is a natural complement to on-line EE. Whether in the use of computer networks themselves, in teacher training, in co-development of curricular materials or on-line projects, or in developing EE programs, on-line networks can nurture mentor relationships by electronic correspondence with individuals or groups. For mentors, the experience can be a valuable co-learning opportunity, as well

as a chance to share experience and expertise. On-line mentoring projects may even pair older students with their younger peers.

Providing opportunities for group feedback on-line can enhance EE efforts. Teacher forums, question-and-answer forums, and general EE discussion forums all exist on various networks, and some are accessible via the Internet. Typically, all participants see and can respond to the feedback of others in these forums, which creates a more empowering dynamic than using only private e-mail for feedback.

Because computer networking is so new, the number of "experts" is far overwhelmed by the rapidly growing numbers of new users, many of whom have new and creative ideas for using the net. Letting the leaders lead is a productive strategy in many classrooms and organizations incorporating computer networks in EE. Whether as co-trainers, local "postmasters," or system operators, the enthusiastic computer nut may be able to provide leadership that the boss, teacher, or workshop facilitator can't, due to lack of experience with the medium or lack of time. In such situations, clear delineation of goals and tasks with periodic review, aids quality control.

Training Techniques

It is difficult, if not impossible, to learn about computer networking from a book or lecture. The best teacher is experience.

The ideal setting for intensive computer network training is a computer lab with no more than two learners per computer, and where each computer has access via modem or direct connection to computer networks. While you're at it, make sure there's no greater than a 10:1 ratio of workshop participants to experienced instructors. And allow at least eight hours in this lab setting for adequate training of beginners.

For groups that continue to work together following a face-to-face training, on-line exercises, group co-tutoring, and "refresher summaries" circulated via electronic mail or on-line conferences can build expertise and confidence.

For those who have to make do with minimal equipment and time, here are some suggestions for how to make the best of your opportunities for computer network training.

Preparation

- Even a single computer with a modem can be a good training device, if the screen display can be made large enough for all workshop participants to see. Liquid-crystal display (LCD) panels allow you to project a computer image onto a screen via a standard overhead projector. These devices are expensive, but worth the investment if budget and ultimate long term use allows. A less expensive option is connecting one or more standard television monitors to the computer. Some computers (such as Apple II, Atari, Commodore, and some new multi-media workstations) provide for video output using standard RCA-plug cables (like those used to connect stereo components together). Computers that do not provide direct connections to TV monitors (such as most Macintosh, MS-DOS, and Windows computers) require either an internal video card or an external coder box (scan converter).

Unless you are lucky enough to be near a university or other large institution, a training lab is the stuff of fantasy. Experienced trainers are even hard to find, since the technology has arisen so rapidly and is in great demand. And of course, don't we all wish we could have lower teacher-student ratios and all the time in the world for learning?

- Set up your equipment for training well in advance. You'll need plenty of time to address technical compatibility (or incompatibility) issues, get access to a phone line for telecommunicating, hook up extension cords, and so on. It almost always is more time-consuming and complicated than you expect, and something often goes wrong, so plan ahead.
- Arrange the training so that the learners can see the computer monitor or projection screen, and so that the trainer looks at the class. It may be helpful to enlist one or more of your teachers to operate the computer keyboard following the trainer's directions.
- Consider pairing or grouping more experienced and energetic workshop participants with those who are new to or pensive about computer technology.

Conducting the Workshop

- Briefly state the goals of the training, and list the skills that the teachers are expected to learn. Provide a checklist for them to monitor their own progress at meeting specific objectives. A sample "I Can Telecommunicate" checklist is provided as a handout in Section IV.
- Dive right in to demonstrating on-line resources, such as computer conferencing, Gopher, and how to get help on-line. Ask teachers what their interests are, then find on-line resources that match those interests. Strive to show the variety, both in form and content, of on-line resources.
- Take short breaks from the on-line demonstration periodically to tell brief stories or anecdotes collected from the network, or to ask participants questions to gauge their understanding of key concepts and how they envision applying computer networking in their own teaching.
- Once "what it can do" has been demonstrated, back up and show how you got there, stepping backwards from a particular on-line resource to the on-line service's main menu or screen. At each step, show and describe the different options that appear in on-line menus or icons.
- Start all over again, this time explaining each step in detail:
  - how to turn on the computer;
  - how to start the communications software;
  - how to set communications parameters;
  - how to make the computer talk to the modem, and to make the modem dial a phone number;
  - how to log in to an on-line service, and why a password is necessary for privacy; and
  - how to access the on-line resources demonstrated previously.
- Save demonstration of electronic mail for last. Once you learn other options like computer conferencing, information retrieval using Gopher, and other tools, e-mail is easy. Learning e-mail first, on the other hand, tends to fill up learners' brains to the exclusion of other modes of on-line networking.
- Present achievable on-line tasks for participants to perform during the training and/or during follow-up sessions (on-line or in person). Consider making these team efforts, and organizing teams to collaboratively develop a product, or to competitively find answers or solutions to a set of questions or problems. Some trainers have developed an "electronic scavenger hunt" where teams search for specific on-line resources or perform assigned tasks such as posting a conference reply or sending e-mail to the instructor. Tasks might include something like the following:
  - Create a "log file" to record all on-line sessions and exchanges conducted to complete the assignment (an electronic journal).
  - Exchange place-of-birth information via electronic mail or an on-line conference.
  - Obtain the geographic coordinates, elevation and population figures for these birthplaces from the Geographic Name Server (telnet to martini.eecs.umich.edu 3000).
  - Find out current and historic meteorological data for each birthplace.

Workshop Activities

Computers Can Talk
You can demonstrate to teachers (and they can demonstrate to students) that computers "talk" over phone lines much like people, by increasing the volume of the modem and using the computer to dial the Time and Temperature Recording or your home answering machine.

Simulate E-mail with Paper
Demonstrate the process of e-mail transmission. Assign one person to be the "node." Then distribute scraps of paper to other participants. They can send these as messages, labeling them with the recipient's name, signing their own name, and giving them to the node. The node distributes messages to recipients. Divide the group into three different networks each with a node. E-mail within a network can be sent to the original first name address. E-mail between networks will require a complete address: "name@network." Message route will now go from sender to local node to receiver's node to receiver.

Down the Gopher Hole
Use the instructions on pages 34-35 to demonstrate a Gopher for environmental educators. Alternatively, gopher to "nceet.snre.umich.edu" and find the tutorial/demonstration. Download this file and adapt it for your participants.

Getting Started
The "I Can Telecommunicate" checklist on page 49 will give new users some concrete, easy tasks and a quick route to early success. You can use this handout to guide participants during independent work time, freeing yourself to answer questions.

Careful Emotional Protocol
Read the following sentence several times with emotional emphasis on different words:

"Thank you for your critical feedback. I'm certain the outcome will be much improved."

Remind participants that verbal conversation includes many visual and intonational cues to improve communication that are notably lacking in e-mail communication. People typically use several tactics to prevent problems, which your workshop participants can practice: rewording inflammatory sentences to be "e-mail appropriate" and using symbols (called "smileys") to indicate humor : -) or surprise : - o

Ask participants to discuss potential problems and ways they might resolve them.

Network Nuances
Using the handout "Ways to Use Computer Networks" on page 48 to lead discussions with the following questions:

- How important are each of the following tasks in your school curriculum?
- How could computer networks improve the way you and your students perform these tasks?
- How would a non-computer user complete the same task compared to the computer approach?
- Are there other ways to use computer networks?
- In what specific ways could computer networks promote and enhance effective EE?

Down the Gopher Hole

The resources of the Internet are so vast that a group exploring a variety of information backwaters can collectively cover more territory than any individual. So in an Internet training session, the group experience can be used to demonstrate the potential for collaborative on-line research.

Using the National Consortium for Environmental Education and Training's "EE-Link" Gopher as an example, here is an idea of how a group might collectively "map the territory" of cyberspace.

Background

First, it is important to think of Gopher as mail-order on the Internet. As in the thick wish-book catalogs of the consumer trade, a Gopher can be dog-eared to mark pages, and its contents can be requested for instant delivery to your desktop.

Unlike those paper catalogs, the topography of gopherspace is changing by the moment. What is here today in a Gopher server may be replaced tomorrow by newer, more polished menus that carry the user far deeper down the Gopher hole. Here we'll work from a view of the EE-Link Gopher in August 1994. (A regularly updated Gopher demonstration/tutorial can also be found on EE-Link.)

Setting up the task

First, point your Gopher at <nceet.snre.umich.edu>. The main menu will look something like this:

```
NCEET's EE-Link
 1. Using EE-Link, the Environmental Education Gopher/
 2. NCEET, The National Consortium for Environmental Education.../
 3. NCEET's Environmental Education Toolbox/
 4. Classroom Resources for Environmental Education/
 5. Literature, Articles & Newsletters on EE/
 6. Grant Information/
 7. Networking: LISTSERVs, Newsgroups, and BBS/
 8. Conferences, Meetings, and Courses/
 9. Environmental Education Organizations, People, and Projects/
10. Education Resources on the Internet/
11. Environmental Resources on the Internet/
```

Have the group practice navigating in Gopher; information about using basic Gopher commands is in the "Using EE-Link . . . " menu.

Split your group into several teams, and assign each a different sub-menu to explore. By selecting a common theme, the group can build a resource list to share. Let's use watersheds and water quality as a theme. Each team will search for information on these topics. Here is one team's search process:

Finding Resources

Select the "Classroom Resources for Environmental Education" menu by typing the number 4, then the <Enter> or <Return> key.

Have the group explore the directories and subdirectories in this menu, and search for materials on "water." A few examples of what can be found:

- water resources curricula reviewed by the California Department of Education
- information on the films *Natural Waste Water Treatment* and *Flush Toilet, Good-bye*
- "Aquatic Tolerance," a secondary-level activity developed for use at the Minnesota Valley National Wildlife Refuge
- "Recycled Water," a lesson plan for an elementary-level laboratory activity
- software developed by the U.S. EPA for exploring groundwater, wetlands, water conservation, and other topics

When the cursor is on any file such as those above, type the letter "a" and add that item to the group's list of bookmarks.

Meanwhile, other teams can put together a similar list of bookmarks for water-related resources in the "Grant Information" or "Environmental Resources on the Internet" sub-menus.

You may also have a team look beyond EE Link for information on water. Luckily, repetitive searching, as for the word "water," is so mechanical that it can be done by a machine. A program called Veronica searches compiled indexes of Gopher menu titles found throughout gopherspace to find key words or text strings, and returns information about their whereabouts. Find Veronica in the "Internet Resources" on the EcoNet Gopher ("Environmental Resources . . ." on the EE Link main menu).

Veronica's companion program, Jughead, will perform similar searches on menus of the local Gopher server you are using. Think of Veronica as the one who likes to go out on the town, and Jughead as the one who stays at home on the couch, and you'll get the picture.

Putting It Together

Have each team report on their findings —what they found useful, interesting, or fun. Show participants how they can reveal the link that any bookmark (or any Gopher menu item) actually represents. With the cursor on the item, press the "=" key. Here is an example of what you might see:

```
Name=EE Resources from the Rainforest Action Movement

Type=0
Port=70
Path=0/orgs/ran/teachers
Host=gopher.igc.apc.org
```

This link information gives the address of the resource on the Internet. In this case, the "host" is a Gopher at the Institute for Global Communications, and the "path" indicates the directories that contain the file.

Teams can record this link information in order to share their bookmarks with other teams. If individuals have their own Internet accounts, they can also incorporate each other's bookmarks into their own personal bookmark files.

An Ongoing Relationship

Today the students in my reading class wrote messages to the students at Sunnyside about the first snow storm of the winter to hit Seattle. We don't get snow often, so when it comes it's a big event. My students wrote their messages in their journals, then they came to me and read their messages while I typed them on the computer. I asked the children to read the screen to make sure I typed the message correctly.

This is kind of an ongoing relationship between the two schools that evolves as we talk about what we are doing throughout the school year. So I don't know exactly when the "project" will end. But we hope to have several products at the end of the school year to show what is possible between first-grade classrooms.

– Jane McLane, first grade teacher,
Kimball Elementary, Seattle

On-Line Projects

Three general classes of educational telecomputing activities — interpersonal exchanges, information collections, and problem solving — have been identified by Judi Harris at the University of Texas, Austin (Harris, 1994a, 1994b, 1994c). Within each class, she lists five or six different activity structures. The following list is a sampling of projects that have enhanced EE, seen through the lens Harris provides.

Interpersonal Exchanges

These are the most basic aspects of networking. At the simplest, two individuals can share ideas and information as network "keypals." Even an on-line exchange between two individuals can enrich each participant's view of the world.

Among professional educators, this type of personal interaction can relieve isolation by establishing regular correspondence with distant colleagues and peers. It can provide continuity between professional meetings and conferences, extending the informal "hallway time" that is so valuable in face-to-face meetings and schools, and opening new opportunities for collaborative work. The computer with modem, in this way, becomes a sort of "virtual water cooler" that transcends geography and time zones.

Partnering

Ensure classes or groups can take basic on-line matchmaking a step further. In the classroom, this typically involves co-reporting on similar studies.

Such projects can work even with very young students, as in an on-line partnership between two first-grade classes studying water. The teachers "met" in an on-line conference devoted to teacher- and student-initiated projects on the International Education and Resource Network (I*EARN). One class had been observing a local pond; the other, a saltwater estuary, and each class (with the teacher as typist) sent messages to the other about its observations. The project expanded to include exchanges of stories about parents and elders.

Electronic "Appearances"

Noteworthy individuals such as scientists, explorers, or experts in some aspect of environmental study, can be invited to participate temporarily on-line via electronic mail or in computer conferences as an extension of the personal on-line exchange. Likewise, electronic mentoring — connecting subject-matter specialists with students for co-exploration of specific topics — can be an enriching experience for both students and mentors.

On Cleveland Free-Net's Academy One, "Spotlight on People" connects students with leaders, inventors, authors, and other professionals. The "Electronic Emissary," based at the University of Texas at Austin, matches subject-matter volunteers with classes. Scholastic Network says on-line appearances by authors and experts are among its most popular offerings.

(See "Network Service Providers" in Section V for contact information on programs mentioned here.)

Expeditions

Following travelers to far-flung places is a popular project theme on computer nets, a sort of electronic "field trip."

In early 1994, teachers and students were able to interact with the JASON Project's expedition to Belize via computer networks, communicating with scientists exploring rain forest canopy and reef ecology, as well as the local culture and history. The project included an extensive written curriculum and video broadcasts.

Another on-line "expedition" made use of a fictional journal of a trip through Belize to guide study and discussion among classrooms on the International Education and Resource Network (I*EARN) and PBS Learning Link networks. These two networks, together with the FrEdMail/SchoolNet networks, Big Sky Telegraph in Montana, and the Texas Education Network joined in a collaborative cross-network effort to share information on action-oriented rainforest projects. Their People Linking Across Networks (PLANET) project was intended to demonstrate the collective potential for educational networks to "make a difference" in the planet's future.

Information Collection and Exchange

Collection and exchange projects range from newsletters jointly produced via e-mail and computer conferencing, to organized development of environmental databases. Here are a few examples:

- Students at a high school in New York collect environmental news stories from elementary and secondary students on the computer networks by posting requests in on-line conferences and mailing lists frequented by students and teachers. They then publish a magazine, on-line and on paper.
- North American Birders Hotline Cooperative members post regular reports of unusual bird sightings in all regions of the continent to Internet mailing lists.
- National Weather Service reports for any location in the United States are available on-line, and a graphical Gopher program called "Blue Skies," developed at the University of Michigan, allows retrieval of weather information by pointing to locations on a color map.
- A number of projects have students conduct "waste audits" — collecting data on the amount of trash they generate, and comparing the results with partner schools via e-mail. A specialized electronic mailing list even exists just to share school/campus environmental improvement information. Called the "Green Schools Discussion List," anyone can subscribe by sending a one-line e-mail message to <listserv@brownvm.brown.edu> saying simply "subscribe grnsch-l" (without the quotes).

Once data collected at multiple sites via projects such as these are pooled, the numbers can be evaluated to track changes or to detect patterns.

The idea of scientists and teachers co-designing real environmental field study is one of the most popular themes in EE networking. Vice President Al Gore even proposed, in his book, *Earth In The Balance*, (1992), students and teachers around the globe join with scientists to collect environmental data. The concept has taken root in his GLOBE program (Global Learning and Observations to Benefit the Environment), with a goal of creating an international science and education partnership in which K-12 students will collect environmental data and share it with each other and the international community of environmental scientists. Details on the GLOBE program are available by sending electronic mail to <info@globe.gov>.

Problem Solving

Groups and individuals can collaborate on projects that achieve "authentic learning" by applying knowledge gained to resolving real-world environmental problems in their own locales. These networks of learners can reinforce and strengthen one another over time, building sustainable on-line communities that flourish while their individual memberships change.

Problem solving projects can be competative or collaborative, but most examples in EE stress collaboration.

There are variations on the theme. The National Geographic Kids Network involves hundreds of classrooms in acid rain monitoring, sharing the data between schools across a computer network, and collectively analyzing it with the help of scientist mentors.

The TERC Global Laboratory Project aims to put real science in the classroom by devising monitoring and assessment methods that allow students to produce scientifically valid results with low-cost technology.

On-Line Simulations

Simulations and gaming create role-playing opportunities for participants to try their hand at any number of experiences. Project IDEALS, run by the University of Alabama, using simulation-management software called Polnet II, has student delegates' countries at an international conference negotiate treaties on issues like chlorofluorocarbon emissions, use of ocean resources, and development on Antarctica.

Environmental Action Projects

Unlike simulations, these are the real thing. Computer networks can be used to mobilize action in many different ways — from working to change public policy to cleaning up pollution.

The United Nations Conference on Environment and Development in Rio de Janeiro included citizens and non-governmental organizations in the preparatory process and in developing the Agenda 21 document with extensive use of global electronic mail and conferencing via the Association for Progressive Communications (APC) networks, including EcoNet in the United States. Continuing on-line efforts as follow-up to UNCED are being made by the Citizens Network for Sustainable Development (phone (319) 324-4941) and the President's Council on Sustainable Development.

The League of Conservation Voters, together with EcoNet, has electronically published the environmental voting records of members of Congress on the Internet. This information is available by Gopher or WWW (to <gopher.igc.apc.org> or <www.igc.apc.org>). The WWW version includes photos of key legislators and a point-and-click map for accessing information on state delegations.

Schools have used e-mail and on-line conferencing to coordinate a fund-raising effort to put sanitary rope-pump well systems in rural villages throughout Nicaragua. Students communicated with one another on-line about their efforts, and made personal connections with peers in Nicaragua. The students also learned about rural water quality and waterborne disease, and about how their small, individual actions can

collectively make a meaningful difference in the quality of others' lives and environment. Contact I*EARN via e-mail at <iearn@igc.apc.org>.

The Global Rivers Environmental Education Network (GREEN) links community-based watershed education networks internationally. While each of the participating programs is locally organized and directed, the network facilitates exchange of the results from standardized water quality monitoring. GREEN takes the process a step further to include not only assessment of the causes of pollution, but also design of action steps that can be taken locally to reduce or eliminate it. Contact GREEN via e-mail at <green@green.org>.

Distance Learning

On-line courses and symposia include traditional lecture and seminar-format classes that "gather together" in the on-line environment. In fact, because each student can have the individual attention of the teacher via electronic mail, the on-line medium even offers some opportunities to improve the student's access to the instructor.

The lack of face-to-face interaction can be a drawback to on-line courses, but this is increasingly overcome by using video — either broadcast or taped — as the delivery mechanism for a lecture or presentation, complemented by the use of e-mail or computer conferencing for questions and discussion, even for turning in student assignments and for testing. The Public Broadcasting Service is launching a new on-line communication and information service, PBS On-line, that merges public television programming and computing. The service will take advantage of new satellite technology to build a two-way interactive data network through local public television stations. Cornell University is developing CU-SeeMe software which allows for real-time, multi-party video conferencing over the Internet at minimal cost.

The U.S. Department of Education's Office of Educational Research and Improvement (OERI) has developed an "infobase" of distance learning projects at the elementary and secondary levels, including a listing of schools using a variety of technological delivery systems (audiographics, satellite, fiber optics, micro-computer-based systems), student courses produced, teacher training provided, number of sites participating, and a description of how information is delivered to the classroom.

How To Seek On-Line Partners

Classroom teachers and community education organizations have several on-line options for joining or initiating projects and soliciting partners elsewhere in the world. First, you should familiarize yourself with networking, observing what is going on in some of the public forums, then decide which is most appropriate for you. Select a network that matches your interests, then plan to use conferencing and/or electronic mailing lists to share your project ideas and to seek partners.

When initiating a project, the more specific you can be, the more likely you are to succeed. Describe the types of data to be collected or activities to be conducted, provide formats and specific measures for information sharing, describe how the project fits school curriculum (if appropriate), be clear about what you expect from others, and include a timeline for when you want it.

Usually it's best to post a short summary of the project solicitation in only the most relevant on-line mailing lists or conferences, and ask those interested to reply to you via e-mail. Some on-line networks provide forms and special conferences for such postings. If you already have prepared a more thorough project plan, you can send an immediate reply to any inquiries. Be sure to include a few personal, lively questions with each message. As in a conversation, getting the other person to talk about himself or herself is a pretty good strategy.

Summary

Computer networking can be a valuable tool for environmental education, especially in broadening communication among educators and students and expanding environmental education to include scientists, citizen groups, businesses, and government agencies. Computer networking is a new medium, largely unexplored and fraught with challenges, and should be viewed as a supplement to rather than as a replacement for conventional communication media.

Once the barriers of access to the technology and understanding the language of telecommunications are passed, computer networks can provide new avenues for tapping valuable information, and more importantly, for building new relationships with other people via on-line projects that can take a variety of forms. But to keep the likelihood of success high in any on-line effort, essential elements must be incorporated: incentives to use the medium; clear goals, objectives, and rules; and adequate support for on-line users.

The last of these, support, bridges the realms of teacher training and ongoing facilitation for computer networking. While adequate, hands-on training in using on-line networks is important at the outset, the trainer's role is most effective when continued as an interactive, co-learning participant in a networked community that supports environmental education.

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Handouts and Overheads for Teacher Workshops

IV

THE FOLLOWING MASTER PAGES can be used either as a handout for workshop participants or as the master for an overhead transparency. In some cases you may want to use them for both purposes.

1 **Problems in Perspective**

2 **Promises in Perspective**

3 **Anatomy of a Green Computer User**

4 **Educational Technology Center for EE**

5 **Five Ways to Use Multimedia Technology**

6 **The Internet**

7 **Ways to Use Computer Networks**

8 **"I Can Telecommunicate" Checklist**

9 **Models for On-Line Learning**

Master 1

Problems in Perspective

Technological Misapplication

- Just because we have a new set of hammers, doesn't mean that everything becomes a nail.
- The inherent limits of educational technologies should not compromise what we know about how people learn best.

Inequity of Access

- Access to new educational technology is increasing rapidly, but not for everyone.
- Limited training and technical support can further impede computer-aided education.
- In order for computer-aided environmental education to be effective, it must be affordable and accessible to all.

Environmental Activity Substitution

- At what point does increased computer use become an artificial and unproductive substitute for interaction between people and the natural world?
- Computer-aided environmental education should be used as a catalyst or extension, and never as a substitute, for field-based exploration or instruction.

Environmental Impact

- Computing is not as "green and clean" as we might like to think...but significant progress is being made.
- Environmental educators should undertake an especially critical and comprehensive environmental analysis of new technologies.

Master 2

Promises in Perspective

Computer-Aided Environmental Education can...

- encourage fundamentally different forms of interactions among students and between students and teachers
- engage students systematically in higher-order cognitive tasks
- facilitate student-centered learning by allowing choice in the pathways and rate of information
- motivate student interaction, experimentation, and cooperative learning
- address a variety of learning styles and modalities
- provide a rich variety of instructional approaches
- involve both learners and experts
- facilitate "storylines" or thematic learning
- prompt teachers to question old assumptions about teaching and learning
- allow teachers to be a guide at students side as well as the sage on the stage
- provide easy access to current local and global environmental data

Master 3

Anatomy of a Green Computer User

A "green" computer user

- has a "portable" computer with:

  an active-matrix color screen

  "sleep mode" capacity

- uses computers manufactured in a CFC-free process

- uses machines that emit no VLF and very little ELF radiation

- has an "ink jet" printer

- has batteries that don't contain cadmium

- uses e-mail instead of paper "snail" mail

- recycles old computers by donating to a school or non-profit organization

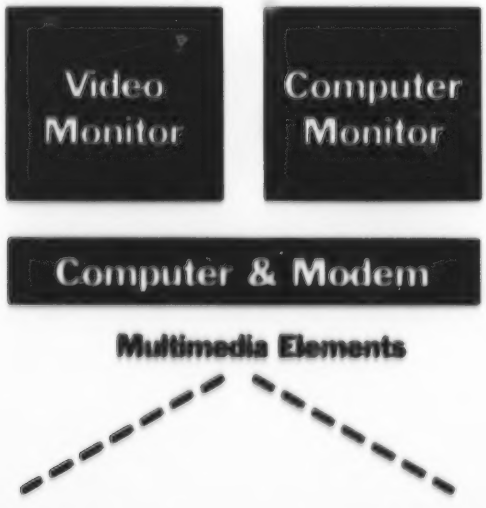
- uses both sides of paper, then recycles

- uses recycled paper and printer cartridges

Master 4

Educational Technology Center For EE

This is a hypothetical center that combines multimedia, on-line and field-based learning technologies.



Potential Technical Connections and Extensions

CD ROM and laserdisc player

Internet, World Wide Web, digital satellite and/or fiber optics

VHS videoplayer

Monitoring and measurement devices

Laptop computer for field-based data entry and analysis

Flatbed scanner and ink-jet or laser printer

Large screen projection device for both video and computer monitors

Potential Teaching and Learning Examples

Classroom presentation and demonstration

Environmental simulation and scientific analysis

On-line learning

Collaborative and individual student learning station

Development and presentation of multimedia reports and curriculum

Classroom record management

Student assessment

Master 5

Five Ways to Use Multimedia Technology

Lecture/Presentation
Connect a single computer to a projection device for providing audio visual support to emphasize lecture points.

Collaborative Learning
Utilized as a learning station in a classroom, interactive multimedia enables small groups to share their expertise and to explore the learning process together.

Individualized Learning
The student controls the pace in a "hands-on" learning experience and can back up, repeat a segment, or ask for further explanation.

Creating Reports or Presentations
With authoring and desktop publishing programs, students can prepare a variety of audio visual reports.

Assessment
Computer technology puts feedback on progress within reach of each learner, provides powerful tools for building student portfolios, and lends itself to more sophisticated testing procedures.

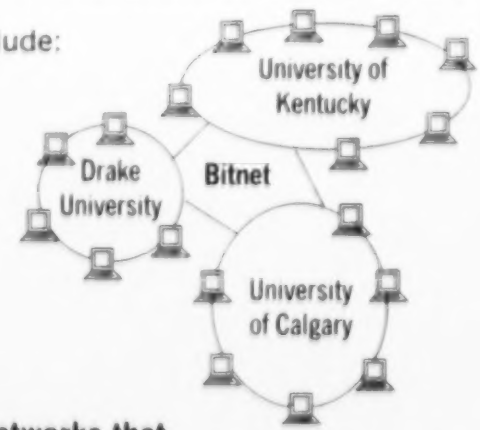
Master 6

The Internet

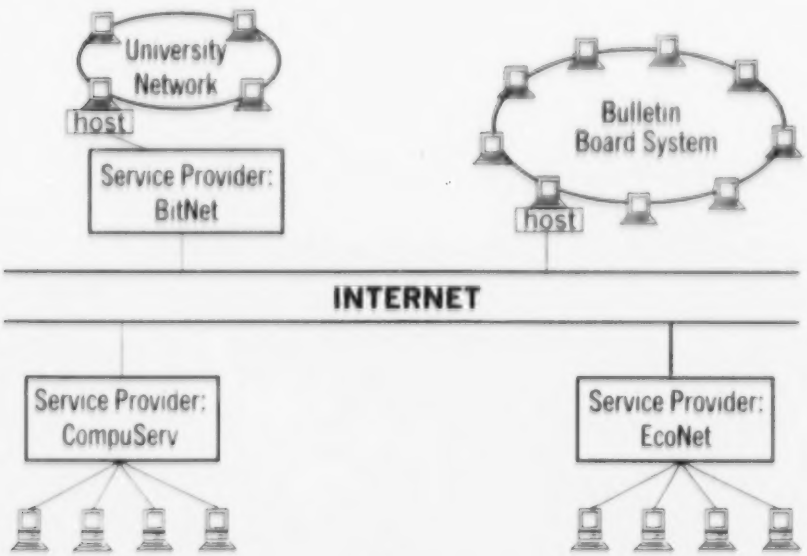
Network: A connection of two or more computers.

Small networks are usually linked by telephone lines.
Examples of small networks include:
- Office or school networks, Local Area Networks (LAN)
- Bulletin Board Systems (BBS), for small communities

Larger networks can be connected by telephone lines, fiber optics, radio, or satellite.
Examples of larger networks include:
- Bitnet, an academic network
- EcoNet, a non-commercial network
- CompuServe, a commercial network



Internet: a global network of networks that exchange information through a common communication standard (TCP/IP).



Master 7

Ways to Use Computer Networks

Glean Information

Receive action alerts and timely news

Look up information on other individuals and groups

Search resource lists

Broadcast Information

Post time-urgent announcements to broad or selected audiences

Publicize conferences, events, calendar of activities, and services available

Post newsletters or other documents for broad access

Communicate Interactively

Ask questions

Dialogue with friends and colleagues

Hone opinions and positions

Work Together

Coordinate meetings and plans

Link to other electronic mail and database systems

Make decisions with dispersed members

Plan conferences and follow-up

Publish on-line (newsletters, occasional papers, etc.)

Coordinate a group-authored paper

Also...

Reduce phone expense and eliminate phone tag

Dial locally, act globally

(Adapted from the "Guide to Creative Conferencing," Institute for Global Communications)

Master 8

"I Can Telecommunicate" Checklist

Check off these mileposts as you complete them. Take your time, and don't worry if you meet goals in a different order than shown below.

- ☐ I know how to turn my computer on.
- ☐ I know how to make my computer talk with my modem. (Hint: Use your telecommunication software to bring your modem to attention.)
- ☐ I can adjust the speed, data bits, stop bits, parity, and flow control in my telecommunication software.
- ☐ I can make my modem dial a phone number.
- ☐ I have successfully connected with an on-line service.
- ☐ I have an account on an on-line service.
- ☐ I can send electronic mail.
- ☐ I can upload a text file and send it as electronic mail.
- ☐ I can read my electronic mail, save a copy on disk, and print a copy on paper.
- ☐ I can read an on-line conference.
- ☐ I have successfully posted a message in an on-line conference.
- ☐ I know how to find on-line conferences that focus on specific subjects.
- ☐ I can use telnet to connect to a remote computer on the Internet.
- ☐ I can use Gopher to browse resources on the Internet.
- ☐ I can use Veronica to search gopherspace.
- ☐ I can use FTP to retrieve files from remote computers on the Internet.
- ☐ I can use Archie to search for files in FTP directories.
- ☐ I can browse the World Wide Web.

Master 9

Models For On-Line Learning

- Interpersonal Exchanges
- Partnering
- Electronic "Appearances"
- On-Line Expeditions
- Information Collection and Exchange
- Problem Solving
- On-Line Simulations
- Environmental Action
- Distance Learning

The File Folder

THE FILE FOLDER contains numerous resources to assist workshop participants and leaders. Many of the following pages could be duplicated as handouts; additional resources can be found in Section IV, Handouts and Overheads for Teacher Workshops.

Computer Basics 52
- Hardware: Get Physical 52
- Software: Making Your Computer Run 52
- Local Area Networking 53
- A Word on Safety 54

Helpful Publications and Other Resources 54
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- Organizations and Institutions 54
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Product Reviews 64

The Greening of Computers 64

Glossary of Computing Terms 65

Computer Basics

Some of your workshops may have participants starting from scratch. These definitions and examples give you the information you need to explain how computers work.

Hardware: Get Physical

Typically, desktop computers, regardless of brand or type, have three pieces of hardware:

1. the **console** or CPU (central processing unit) is the box that contains the electronic chips and wires that make up the computer's "engine,"
2. the **keyboard,** on which you type directions or commands, and
3. the **monitor,** a television-like screen.

These three components are the essential hardware, the physical equipment or machinery of your computer system. These days, hardware comes in a bewildering array of sizes, capacities, and speeds, all identified by acronyms and numbers that, like automobile engine numbers, are usually indecipherable at first glance.

The **microprocessor** is the main computer chip. The numbers describe its speed and capabilities. New programs designed for the higher model numbers may not work on older machines.

Kilobytes (K or KB) and **megabytes** (MB) are numerical measures of how many characters, or "bytes," your computer can handle at once or store permanently. In Greek, *kilo* means "thousand", *mega* means "million". One megabyte equals about 500 pages of text.

RAM stands for random-access memory. It's a measure of how much information your computer's memory can hold while it is on. To preserve your data when the computer is turned off, you must first transfer or save it to either a hard drive or a diskette.

The **hard drive** houses spinning magnetic recording platters (sometimes called a hard or fixed disk) that store information permanently inside your computer or in an attached box. **Diskettes** are the plastic square jacket-covered magnetic recording disks that you insert into a slot (the diskette drive) on the front of your machine. Diskettes may measure 3.5 or 5.25 inches. "Diskette" is often abbreviated to "disk," or called a "floppy disk."

Information may also be stored on **CD-ROMs** or **laserdiscs,** which require special players attached to the computer. These discs store massive amounts of data, including full-motion video, on laser-etched foil embedded in clear plastic.

Software: Making Your Computer Run

To make your hardware run, you need **software.** This is the generic word for the various programs that tell your computer what types of tasks to perform. Commercially available computer programs, from "space alien" games to sophisticated do-it-yourself income-tax accounting packages, come on copyrighted, name-brand disks at prices ranging from $10 to several hundred dollars.

Basically, there are five broad applications for software in everyday use in the business world (and increasingly, in the world of education).

1. To type and edit manuscripts, stories, or reports and then print them out, you'll need a **word-processing** application.
2. For working with long mailing lists, catalogs of items in inventory, or encyclopedic reference materials, the software application of choice is a **database.** Since the popular on-line encyclopedias for library and school use have database management (search) functions already built in, you've probably already manipulated a database without realizing it.
3. For mathematical calculations such as figuring a budget or averaging grades, you need a type of software application called a **spreadsheet.**
4. Communications software and modems are the two computer accessories that allow computers to communicate by telephone. With this equipment, described together as **telecommunications,** you can dial up, log in to, and communicate with hundreds of services, such as electronic bulletin boards, newspaper data services, on-line services, and anyone else with a modem.

5. Illustration, animation, and digital video are manipulated using **graphics** software.

Some computer software programs designed specifically for education integrate word-processing, databases, spreadsheets, telecommunications, and graphics software into easy-to-use packages.

Fortunately for teachers and students, the complex underpinnings of these programs are invisible during use, just as the internal interactions of pistons and valves are invisible inside a car's combustion engine when you start the motor. The important interaction to notice in the classroom is this: Today's students, attuned to the magnetic impact of Nintendo and MTV, gravitate toward technology. When technology is used effectively, even at-risk students become active participants in learning that is colorful, challenging, interactive, and fun.

Certain **specialty software** applications expand classroom or media center resources beyond specific courseware.

1. **Desktop publishing** software enables your students to turn their written projects into professional-looking news letters or books, complete with big headlines and artwork.
2. **Administrative and bookkeeping tools** let you track attendance and grades quickly and easily by computer.
3. **On-line reference and research programs** allow searching through library catalogs or other databases by computer.
4. **Microcomputer-based laboratory software** allows analysis of scientific data, including results of environmental monitoring.
5. **Geographic information systems (GIS)** allow data and graphical elements to be displayed visually on multi-layered maps, and analyzed based on spatial characteristics.

Local Area Networking

All of a school's or organization's courseware, administrative tools, and other software applications, such as word-processing, may be stored on one or more "file servers" to which other computers are connected via a local area network. A user "logs in" to the network and chooses the programs and files he or she wants to use by typing in assigned access or identification codes.

Within seconds, the programs are on the screen and the user is at work. When the user is finished, information such as a report or data file may be saved on a diskette inserted into the computer's disk drive, for safe-keeping, privacy, or to use on another computer. (Diskettes used to store personal work are sometimes called data disks, as distinguished from software program disks.) Alternately, the user may save work directly to the file server's hard drive, a procedure that totally eliminates handling of diskettes.

The technical aspects of local area networks can be complex; however, computer networking professionals usually handle the installation. Networking may also require a bit of remodeling to accommodate all of the cables and wires.

Happily, trainers and teachers who use networks have other details to focus on. For example:

- Networking opens up a vast range of education resources, from cross-curricular courseware to school media center holdings to research data in state departments of education.
- Networking allows the teacher to select levels for different groups of learners – grade-level work for mainstream students, more challenging or higher-level work for students ready for enrichment.
- Networking allows the teacher to monitor classwork by computer.
- Networking makes it possible for teachers to communicate with each other and with school and district administrative offices quickly and conveniently through electronic mail.
- Networking increases productive computer work time by reducing the need to handle disks and by automatically sending data to a shared printer.

A Word on Safety

Computers are electronic equipment. They and their attachments — printers, CD-ROM and laserdisc readers — run on electricity. Therefore, treat your computer as you would any other sensitive electrical appliance. That means adequate wiring, surge protectors, no coffee or soft drinks nearby, and wires and cords kept securely out of harm's way. Before you add peripherals or move things around, be sure your machine is turned off and unplugged.

Diskettes are quite sturdy, but there are a few points to remember:

1. Magnets and magnetic fields, such as airport X-ray machines, magnetic paper clip holders, stereo speakers, and even some telephones, can destroy the data on your diskettes if they get too close.
2. Like film, diskettes last longer at room temperature, not in an overheated automobile glove compartment or in direct sunlight.
3. The diskette should slide easily into the disk drive slot; if the slot is working properly and the diskette is not damaged, there's no need for force.
4. If the information on a diskette is especially valuable to you, make a copy.

Helpful Publications and Other Resources

Educational Technology Journals and Trade Publications

Classroom Computer Learning Technology on Campus, 2451 East River Road, Dayton, OH 45430

Educational Technology, Educational Technology Publications, 700 Palisades Ave., Englewood Cliffs, NJ 07631

Electronic Learning, 730 Broadway, New York, NY 10003

Electronic School: Innovative Uses of Technology in Education, National School Boards Association, 1680 Duke St., Alexandria, VA 22314

Instruction Delivery Systems, Interactive Instruction Development, 50 Culpepper St., Warrenton, VA 22186

Interact, International Interactive Communications Society, College of Communications, California State University, Chico, CA 95929-0504

Media and Methods, 1429 Walnut St., Philadelphia, PA 19102

On-line Access, 920 N. Franklin St., Suite 203, Chicago, IL 60610

T.H.E. (Technological Horizons in Education) Journal, P.O. Box 17239, Irvine, CA 92713

The Computing Teacher, Journal of the International Society for Technology in Education, University of Oregon, 1787 Agate St., Eugene, OR 97403-9905

The Videodisc Monitor, P.O. Box 26, Falls Church, VA 22046-9990

Organizations and Institutions

Association for Educational Communications and Technology, 1126 16th St., N.W., Washington, DC 20036

Institute for the Transfer of Technology to Education, National School Boards Association, 1680 Duke St., Alexandria, VA 22314

International Communications Industry Association, 3150 Spring St., Fairfax, VA 22031

International Interactive Communications Society, 2298 Valerie Court, Campbell, CA 95008

International Society for Technology in Education, University of Oregon, 1787 Agate St., Eugene, OR 97403-9905

Interactive Video Industry Association, 1900 L St., N.W., Washington, DC 20056

National Demonstration Lab, Smithsonian Institute, Arts and Industries Building, Room 1130, Washington, DC 20056

Society for Applied Learning Technology, 50 Culpepper St., Warrenton, VA 22186

Technology Resources Center, U.S. Department of Education, 80 F St., N.W., Washington, DC 20208-5725

Books

The Big Dummy's Guide to the Internet. Electronic Frontier Foundation, 1993. This is a great general introduction to the Internet. You can order a hard copy from the Electronic Frontier Foundation or download it from many networks and bulletin boards. Available from:

Electronic Frontier Foundation
1001 G St., N.W., Suite 950 East
Washington, DC 20001
✆ 202 347-5400

Cognition, Education, and Multimedia: Exploring Ideas in High Technology, D. Nix and R. Spiro (eds.), 1990. Available from

Lawrence Erlbaum Publishing
365 Broadway
Hillsdale, NJ 07642
✆ 201 666-4110

Computer-Aided Environmental Education, W.J. "Rocky" Rohwedder, ed., 1990. North American Association for Environmental Education ($16 postage paid). This monograph contains 21 articles covering the problems and promises of the field, interactive multimedia, simulations, software and telecommunications. Available from:

NAAEE
P.O. Box 400
Troy, OH 45373
✆ 513 676-2514.

Great Teaching in the One-Computer Classroom, David Dockterman, 1991. Tom Snyder Productions ($19.95). This highly recommended resource offers practical solutions for turning the computer into a valuable teacher tool both inside and outside of the classroom. A witty and insightful account of how a single computer can help ease administrative burdens, enliven classroom presentations, spark discussions, foster cooperative learning and critical thinking. They also have an excellent accompanying video and Technology Planning Guide. Available from:

Tom Snyder Productions
80 Coolidge Hill Road
Watertown, MA 02172-2817
✆ 800 342-0236

Jargon: An Informal Dictionary of Computer Terms, Robin Williams, 1993. Peachpit Press. ISBN 0-938151-84-3. This great resource both defines words and explains the concepts behind them in a comprehensive, conversational style. Available at most bookstores ($22) or from:

Peachpit Press
2414 6th St.
Berkeley, CA 94710
✆ 800 283-9444.

The Technology Age Classroom, T. Cannings and L. Finkel, 1993. Available from:

Franklin, Beedle & Associates
8536 SW St. Helens Dr.
Wilsonville, OR 97070
✆ 503 682-7668

The Whole Internet User's Guide and Catalog, Ed Krol, 1994. Sebastopol, CA: O'Reilly & Associates. This book shines among the dozens of Internet guides now in print. It is simple and straightforward, but provides good technical detail. The "Catalog" section describes some highlights of the Internet, by subject category, and has a fun introduction to "stalking the wild resource" on the networks. Available from:

O'Reilly & Associates
103 A Morris St.
Sebastopol, CA 95472
✆ 800 889-8969

Multimedia and On-Line Learning Resources

Amthor, Geoffrey. (1993). "Introducing Multimedia in Your Classroom," *EduQuest Teacher's Handbook*.

Anderson, Ronald E. (ed.) (1993). *Computers in American Schools, 1992: An Overview*. Minneapolis, MN: University of Minnesota.

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General Software and Multimedia Catalogs

Educational Software Preview Guide for 1993-94. International Society for Technology in Education, 1993. The guide's contents change every year as new titles are added and previous listings re-evaluated. Those chosen for inclusion are deemed especially good for classroom use. Distributed throughout North America, the guide provides annotated descriptions of each program, available platforms, levels, and publisher's information. Contact your state education agency for a copy or contact:

Anita Best
Consortium Chair
✆ 503 346-2400
e-mail:
<ISTE@oregon.uoregon.edu>

IBM EduQuest Catalog. Available from:

EduQuest
411 Eagleview Blvd.
Exton, PA 19341
✆ 800 769-8322

Intellimation K-12 Macintosh Software and Multimedia Catalog. Available from:

Intellimation
Dept. 2KF
130 Cremona Drive
P.O. Box 1530
Santa Barbara, CA 93116
✆ 800 346-8355

Laser Learning Technologies Catalog. Available from:

Laser Learning Technologies Inc.
120 Lakeside Ave., Suite 240
Seattle, WA 98122-6552
✆ 800 722-3505

Multimedia and Videodisc Compendium. Available from:

Emerging Technology Consultants, Inc.
2819 Hamline Ave. N
St. Paul, MN 55113
✆ 612 639-3973

National Geographic Ed-Tech Catalog. Available from:

National Geographic Society
Educational Services
P.O. Box 98018
Washington, DC 20090-8018
✆ 800 368-2728

Optilearn Environmental Views Series. Available from:

Optilearn Inc.
P.O. Box 997
Stevens Point, WI 54481
✆ 800 850-9480

Preview! Science Software Selected for Junior High through College. Available from:

Cambridge Development Laboratory, Inc.
86 West St.
Waltham, MA 02154
✆ 800 637-0047

Videodiscovery Educational Videodisc Catalog. Available from:

Videodiscovery, Inc.
1700 Westlake Ave. N., Suite 600
Seattle, WA 98109-3012
✆ 800 548-3472

Ztek Co. Educational Multimedia Catalog. Available from:

Ztek Co.
P.O. Box 1055
Louisville, KY 40201-1055
✆ 800 247-1603

Environmental Education Software and Multimedia Catalogs

Computer-Aided Environmental Education Resources, Rocky Rohwedder, 1994. Sonoma State University, Department of Environmental Studies and Planning. 4-5 pages. A regularly updated annotated listing of the author's favorite 20-25 multimedia (laserdisc and CD-ROM), software, clip art, on-line learning resources. Available for $3. Checks payable to "SSU Academic Foundations" and sent to:

Computer-Aided Environmental Education Resources,
EarthLab, Sonoma State University,
1801 E. Cotati Ave.,
Rohnert Park, CA 94928

Environmental Education Software and Multimedia Sourcebook, Mark Patterson and Ron Mahoney, 1993. University of Idaho Cooperative Extension. 104 pages. An excellent first crack at a comprehensive directory. One hundred sixteen programs and 49 databases and image collections are listed. Indexed by title, grade level, format (CD-ROM, software, or laserdisc), and platform (Mac, IBM, Apple II). Only 15 of the more than 200 resources are described and analyzed. A similar effort is needed for the other materials listed. Sources of products and additional information are also included. Available for only $8 from:

Extension Forestry
College of FWR, Room 211
University of Idaho
Moscow, ID 83844-1140
✆ 208 885-6356.

High-Tech Environmental Education: Software, Videodiscs, and CD-ROM Materials — A Review, Tennessee Valley Authority, 1993. A listing, not a review as the title suggests, of existing products. Name, publisher, cost, grade level, description, platform, and ordering information is included for 74 pieces of software, 50 videodiscs, and eight CD-ROMs. The University of Minnesota is developing a software resource guide for elementary and secondary teachers as well as environmental educators. Contact:

Susan R. Thomas
c/o Dr. Simon Hooper
130 B Peik Hall
University of Minnesota
159 Pillsbury Drive S.E.
Minneapolis, MN 55455-0208.

Network Service Providers

Commercial Networks

A variety of commercial services offer networked resources for education, and varying Internet connectivity. For details, contact each directly.

— America On-line (includes "Classroom Earth" and the "Global Action and Information Network"):
✆ 800 827-6364

— AT&T Learning Network:
✆ 800 367-7225

— Classroom Prodigy:
✆ 800 776-3449

— CompuServe:
✆ 800 848-8199

— Delphi:
✆ 800 695-4005

— Genie:
✆ 800 638-9636

— Scholastic Network:
✆ 800 246-2986

— ScienceNet/Omnet:
✆ 617 265-9230

— TogetherNet:
✆ 802 862-2030

— WorldClassroom:
✆ 800 866-4452

Non-Commercial Networks

EcoNet/APC Networks. EcoNet provides dial-up Internet access from anywhere in the United States, including Gopher, telnet, and FTP services, and a broad array of environmental information resources. EcoNet is a member of a world-wide organization of like-minded computer networks — the Association for Progressive Communications. APC aims "to provide a global communications network dedicated to the free and balanced flow of information." APC's partner organizations serve people working toward goals that include the prevention of warfare, elimination of militarism and poverty, protection of the environment, human rights, social and economic justice, participatory democracy, nonviolent conflict resolution, and the promotion of sustainable development. When subscribing to EcoNet, you also gain access to the information resources of the other IGC networks: PeaceNet and ConflictNet. Information available from:

EcoNet
18 De Boom St.
San Francisco, CA 94107
✆ 415 442-0220
e-mail: <econet-info@igc.apc.org>

Global SchoolNet Foundation/FrEdMail (Free Educational Electronic Mail) Network. Since 1985 FrEdMail has been a leader in the instructional applications of telecommunications, particularly in the development of model asynchronous collaborative learning projects. The FrEdMail BBS Network provides Internet e-mail access to thousands of teachers and their students across the U.S. SCHLnet is "FrEdMail on the Internet," offering FrEdMail projects and newsgroups to schools on the Internet.

Global SchoolNet Foundation
P.O. Box 243
Bonita, CA 91908
✆ 619 475-4852
e-mail: <fred@bonita.cerf.fred.org>

K-12Net. This grassroots global network of more than 250 linked bulletin board systems includes subject-specific conferences for teachers and a structure for collaborative project development. Using FidoNet BBS technology, anyone can access K-12Net's on-line forums for free (plus phone charges). The K12Net forums also are accessible on many Internet systems that serve education. Contact:

Janet Murray
1151 S.W. Vermont St.
Portland, OR 97219
✆ 503 280-5280
e-mail: <jmurray@psg.com>

FidoNet is a world-wide network of more than 11,000 bulletin board systems that interconnect to send messages and conferences (called "echoes") to one another, routed following specific rules. To access FidoNet, you need to become a "point," with special software to connect to a BBS node called your "Boss." The "master list" of all FidoNet nodes is the Nodelist, more than 1 million characters long. You can find the nearest FidoNet BBS in the Nodelist or by checking with local computer clubs, computer shops, and BBS system operators.

OneNet. With a goal of establishing an "electronic global nervous system," the OneNet Member Network links Macintosh bulletin board systems that provide the same graphical interface telecommunication software (FirstClass) for Macintosh and MS-Windows users. A set of "SchoolNet" conferences connects K-12 educators and students. Connect by modem to (415)948-1349 for a current listing of local OneNet bulletin boards.

OneNet Los Altos
4546 El Camino Real, # 127
Los Altos, CA 94022
✆ 415 948-5086
BBS: 415 948-1349

National Public Telecomputing Network. NPTN is a network of community "FreeNet" computer systems with affiliates in 30 cities, with more than 80 organizing committees spread over 33 states and much of Canada. First systems have recently gone on-line in Europe. It has a well-developed on-line K-12 service — Academy One — and plans to develop widespread Free-Net systems in rural areas.

NPTN
P.O. Box 1987
Cleveland, OH 44106
✆ 216 247-5800
e-mail: <info@nptn.org>

PBS Learning Link/ PBS On-line Services. The Learning Link national consortium offers educational computer network access via locally managed services provided by Public Broadcasting System affiliate television stations.

WNET/13
356 West 58th St.
New York, NY 10019
✆ 212 560-6613
e-mail: <emarks@ll.pbs.org>

State and Regional Networks

Many state and regional educational computing networks are offering services to the formal and non-formal education communities. For details on options in your area, contact the technology coordinator at your state or local education agency.

Networked Projects and Resources

The following is a sampling of educational projects and resources of value to EE. New resources appear on-line regularly; use this list as a starting point and explore!

Academy One. Academy One grew on the Cleveland Free-Net, a grassroots movement formed by parents, teachers, and volunteers to provide a place where students could "safely" share their messages and where they could learn the technology without bothering adult users. Academy One is now shared on more than a dozen Internet systems. Its projects include places where students can share experiments or research,

and share their involvement in projects that help their communities. Any server-equipped school or district with an Internet connection that can handle Usenet newsgroups and Gopher can place the Academy One program on its system.

Academy One
7151 Lincoln Ave. #G
Buena Park, CA 90620
✆ 714 527-5651
e-mail: <a-1@nptn.org>

EE-Link Gopher. NCEET and EE-Link are funded by the U.S. Environmental Protection Agency to improve EE. EE-Link is intended to be a "one-stop-shopping" location for educators interested in EE. It offers a rich array of on-line resources, including materials collected and created by NCEET, connections to other Gophers valuable to EE.

National Consortium
for Environmental Education
and Training
University of Michigan/ School
of Natural Resources
and Environment
Ann Arbor, MI 48109-1115
✆ 313 998-6726
modem: (313)998-1303
Gopher: <nceet.snre.umich.edu>
e-mail:
<eelink@nceet.snre.umich.edu>
WWW: <http://
www.nceet.snre.umich.edu>

EcoGopher Project at the University of Virginia. EcoGopher is an ongoing project, developed to facilitate access to environmental information. EcoGopher provides easy-to-use links to tremendous amounts of environmental information in electronic form made available by environmental agencies and organizations. EcoGopher also includes Ecolynx, a text-based World Wide Web client program for browsing hypertext documents on the Internet, and EcoChat, an Internet Relay Chat function for real-time on-line conversation about the environment.

Gopher: <ecosys.drdr.virginia.edu>
e-mail:
<Gopher@ecosys.drdr.virginia.edu>
WWW: <http://
ecosys.drdr.virginia.edu/
EcoWeb.html>

CIESIN Global Change Information Gateway. CIESIN provides global environmental information services through a Gopher server that provides gateways to government agencies participating in the U.S. Global Change Research Program.

Consortium for International Earth
Science Information Network
2250 Pierce Road
University Center, MI 48710
✆ 517 797-2700
e-mail: <ciesin.info@ciesin.org>
Gopher: <gopher.ciesin.org>

Global Rivers Environmental Education Network. GREEN uses watersheds as a theme to link people within and between watersheds to build an international network of people and institutions to encourage global sharing and cooperation, and to foster cross-cultural sensitivity and respect for different ways of thinking. GREEN has programs in all 50 states, and 125 countries. Each watershed project is unique, developed according to the goals and situation of the local community. In all, students investigate the health of their local river, studying biological and physical parameters as well as its history. GREEN watersheds have their own on-line conferences on EcoNet and the APC networks.

.GREEN
721 E. Huron
Ann Arbor, MI 48104
✆ 313 761-8142
e-mail: <green@green.org>

International Education and Resource Network. I*EARN was founded in 1990 by the Copen Family Fund to facilitate student telecommunications projects that make a meaningful difference in the health and welfare of the planet and its people, and to establish demonstration sites at which telecommunications is effectively integrated into the curriculum. Six "centers" in the United States and eight in other countries manage the network of more than 400 K-12 schools in 23 countries. On-line structures and mentoring processes facilitate collaborative projects in five subject areas, including environment/science. Ongoing environment/science projects include measurement of ultra-violet radiation to study ozone depletion, studies of lake and river quality and an environmental newsletter produced by students on-line. I*EARN maintains a set of on-line conferences on EcoNet and the APC networks.

I*EARN
345 Kear St.
Yorktown Heights, NY 10598
✆ 914 962-5864
e-mail: <iearn@igc.apc.org>

JASON On-line. JASON On-line is part of a comprehensive, national teacher in-service training program administered by the JASON Foundation for Education and sponsored through the Eisenhower National Program for Mathematics and Science Education, United States Department of Education. JASON On-line is designed to introduce teachers to the world of telecommunicating and to provide additional resources such as classroom tips, lesson ideas, and on-line support for teachers using the JASON Project and the JASON curriculum. If you are already using a service that gives you telnet access to other Internet sites, you can reach JASON On-line this way:

telnet <topcat.bsc.mass.edu>
login: Jason
password: guest

ENVST-L — The Environmental Studies Discussion List. This electronic mailing list is devoted to discussion of environmental studies at the undergraduate and graduate levels. To subscribe, send an e-mail message to <listserv@brownvm.brown.edu> containing the following single line of text: subscribe envst-l <your name>

GRNSCH-L — The Green Schools Discussion List. This on-line mailing list is intended to facilitate information exchange between individuals at colleges and universities who are attempting to mitigate the impacts of their institutions' activities on the environment. To subscribe, send an e-mail message to <listserv@brownvm.brown.edu> containing the following single line of text: subscribe grnsch-l <your name>

National Geographic Kids Network. Kids Network is an international telecommunications-based science and geography curriculum for grades four through six. Students conduct local investigation on topics such as water supply, weather, pollution, and solar energy, then compare their data with other members of their research team on-line, with help from on-line scientists in interpreting patterns in the data.

National Geographic Society
Attn: Educational Services
P.O. Box 98108
Washington, DC 20090-8018
✆ 800 368-2728

Nonpoint Source BBS. This Environmental Protection Agency bulletin board system is an example of the types of specialized resources available via systems that may or may not be connected to the Internet. The NPS BBS provides an exchange of information and expertise on water quality and related topics. A copy of the U.S. EPA Nonpoint Source Information Exchange

Computer Bulletin Board System (BBS) User's Manual (Publication number EPA 503/8-92/002) may be ordered by mail or fax at no cost from:

NCEPI
11029 Kenwood Road, Building 5
Cincinnati, OH 45242
Fax: (513)891-6685.
BBS: 301 589-0205
telnet: <fedworld.gov> then follow the BBS gateway menus

TERC Global Laboratory Project. Developed by TERC with support from the National Science Foundation, the Global Lab is an international network of schools linked by telecommunications, shared curriculum, and common goals. Global Lab students learn science through hands-on investigations of their environments and those of their peers around the world. As they conduct valuable collaborative research, students learn scientific skills, experimental techniques, and advanced technologies.

TERC Global Laboratory Project
2067 Massachusetts Ave.
Cambridge, MA 02140
✆ 617 547-0430
e-mail: <gl@terc.edu>

WhaleNet. WhaleNet, in conjunction with the Whale Conservation Institute (WCI) and whale watch companies, is developing a program to enhance the educational use of whale watches. This National Science Foundation-funded teacher enhancement project offers curriculum support and a source of data for interdisciplinary classroom activities, and interactive on-line informational support. WhaleNet is setting up a system where students, teachers, and WCI will collect data on their whale watches and compile their data on the WhaleNet/Marine bulletin boards on EnviroNet, and share it via the Internet. EnviroNet's purpose is to enhance environmental science education in New England through the use of telecommunications.

Michael Williamson
WhaleNet director
c/o Environet
Park Science Building
Simmons College
300 Fenway
Boston, MA 02115
✆ 508 468-4699 or
617 734-5200, ext. 256
e-mail:
<mwilliamson@vmsvax.simmons.edu>

Environmental Database Resources

Environment On-line...The Greening of Databases. Database Magazine, 1991-92. 88 pages. This three-part series from *Database Magazine* is in an augmented book form and covers scientific, technical, regulatory, legal, business, and general databases. Available for $19.95 from:

Eight Bit Books
462 Danbury Road
Wilton, CT 06897-2126
✆ 800 248-8466

Databases: Sprouting Up Green. Barbara Palladino, 1993. On-line Access, September, pp. 52-56. This introduction to green databases includes a listing of available on-line resources.

Product Reviews

Only the Best: Annual Guide to Highest Rated Education Software/Multimedia for Preschool-Grade 12, published by Association for Supervision and Curriculum Development, 1250 North Pitt St., Alexandria, VA 22314.

The Greening of Computers

The Green PC, Steve Anzovin, 1994. TAB Books, 13311 Monterey Ave., Blue Ridge Summit, PA 17294. (717)794-2191. A paperback handbook on conscientious computing.

The Coming Green Computers, Kellyn Betts, 1994. E Magazine, Vol. 1, No. 2, April 1994. pp. 28-35. An overview of the new federal policies promoting energy-saving computers and cleaner computer production.

Eco-Disks, 100% recycled computer diskettes are available from Eco-Tech, Inc. They purchase obsolete disks from major manufacturers, erase them, test them, and then format them for PC or Macintosh. Lifetime guarantee and 10% of sales go to the Wilderness Society. Contact:

Dr. Disk Works
Eco-Tech
11450 FM 1960 West, Suite 208
Houston, TX 77065
✆ 800 373-4759

Energy Star Computer Program, a program which promotes energy efficiency in computing. Energy Star computers and peripherals go into an energy-saving "sleep" mode when sitting idle. More than 75 companies are already offering Energy Star products.

U.S. Environmental
Protection Agency
401 M St. SW
Washington, DC 20460
✆ 202 775-6650.

The Greening of Computers, Andy Reinhardt, et al. 1992. BYTE, Volume 17, No. 9, September. pp. 147-157. A summary of ways consumers and vendors are engaging in more environmentally sound computing. Includes a great listing of "Green Computing Groups, Products, and Services."

Global Network: Computers in a Sustainable Society, John E. Young, 1993. Worldwatch Paper, 115. pp. 41-47. A comprehensive look at the role of computers in sustainable development. Includes chapters on monitoring and modeling, developing countries and toxic impacts.

Glossary of Computing Terms

account: Your subscription to a networked computer system.

account name: Same as your login ID or user ID. The word you type at the "Login:" prompt; your electronic name.

address: Like a postal address, a "network address" is used to locate another user for the purpose of directing mail. On the Internet this is in the form: account@host.domain.

analog: A method of storing information, used by most audiotapes, videotapes and laserdiscs (and all LP phonograph records, remember those?). An analog device uses a physical quantity, such as length or voltage, to represent the value of a number. By contrast, digital storage relies on a coding system of numeric units.

APC: Association for Progressive Communications, formed in 1987 to promote international communications among organizations and individuals working in the peace, environmental, conflict resolution, health, and public interest communities worldwide. Members include: Alternex in Brazil; Antennae in the Netherlands; ComLink in Germany; Nicarao in Nicaragua; Chasque in Uruguay; Ecuanex in Ecuador; NordNet in Sweden; GlasNet in Russia; GLUK in Ukraine; GreenNet in England; IGC networks (PeaceNet, EcoNet, ConflictNet) in the United States; Pegasus in Australia; SangoNet in Southern Africa; Wamani in Argentina; Web in Canada.

Archie: A program available via the Internet that allows users to easily search remote systems for files or programs that match specified keywords.

ASCII: American Standard Code for Information Interchange (pronounced ask-ee). The form in which text characters are handled in most computer systems and networks. ASCII text has no special characters for formatting such as underlined or bold characters, font changes, etc., thus can be viewed on any personal computer or terminal.

baud rate: The speed at which data is transmitted over telephone lines. For example, a 2400-baud modem sends data at a rate of 2,400 bits (about 300 characters) per second. Two modems can only connect if they can operate at the same baud rate.

BBS: Bulletin Board System (see *bulletin board*).

binary: A file containing one or more strings of data bits which are not printable characters. Some binary files may be computer programs or other forms of data that contain no text characters at all. Binary files cannot be displayed on screen, but can be downloaded for use with appropriate applications on your computer. Binary (base 2) is also the building block of computer information, representing "on" or "off" and "true" or "not true" as 1 or 0.

bit: A binary digit, the smallest unit of data used in a computer; 7 or 8 bits are typically used to represent a single character of text.

bits per second (bps): The speed at which bits are transmitted.

booting: Turning on your computer.

break: A signal sent from a user's terminal to the network, which causes interruption of an activity.

bug: An error. Can be a hardware malfunction or a software programming error.

bulletin board (BBS): A computer system which can be called using a modem.

byte: Computer term for a string of 8 bits. In practice, a byte is usually used to represent an alphanumeric character.

carriage return <CR>: The <ENTER> or <RETURN> key on your keyboard. On-line commands often must be followed by <CR>.

cc: Carbon copy. The prompt in an e-mail program which allows the user to enter one or more ID's to send copies of a message.

CD: Compact disc for audio.

CD-i: Compact disc for audio and visual for movies, reference, training courses and video games. It can be interactive but is not programmable; it is viewed through a television and CD-i player, not a computer.

CD-ROM: Stands for "compact disc read-only memory." Computer CDs are just like music CDs. They are small, shiny "records" that can hold an immense amount of data (up to 550 MB). About 4.75 inches in diameter, a CD must be played on a CD-ROM drive.

CD-ROM drive: A computer accessory used to access CD-ROM discs. Internal CD-ROM drives are installed inside of the computer system. External versions have their own enclosure and power supply and are connected to the computer by a cable. Many computers now include a built-in CD-ROM drive as standard equipment.

character: Any symbol (usually alphabetic, numeric, or punctuation) that can be entered into your computer.

client: Software that extracts information from a server; your auto-dial phone is a client, and the phone company is its server.

command: An instruction you give to an on-line network to carry out a specific action.

conference: An electronic meeting place dedicated to a particular subject where users come to participate in discussions or group projects. Conferences can be used to post a variety of information such as news services, newsletters, and statistics; also called "newsgroups," "bulletin boards," or "echoes." An electronic conference provides a many-to-many communication medium, as opposed to the person-to-person nature of e-mail. All conferences have a particular subject or purpose, and the topics and responses they contain might provide items of news, ideas, questions, or other information in almost any form. Some special-purpose conferences may have restricted access, allowing some users to write messages, some only to read, and some neither. The person responsible for the technical maintenance and/or community communication is called the "conference facilitator."

courseware: Educational programs designed for in-school use.

CPU or central processing unit: The main processor chip in a computer which responds to software instructions and controls peripherals and memory.

cyberspace: The virtual realm where on-line communication occurs.

database: A collection of information that can be sorted and searched in a variety of ways.

default: A software function or operation which occurs automatically unless the user specifies something else.

delete key: Personal computers normally allow deletion of typing mistakes by either the backspace key or the Del key. Users must either specify which of these keys they wish to use, or set their communication software to match whichever key the network expects.

dial-up: To connect to a computer by calling it on the telephone.

digital: Used in computerese to describe information that can be represented by a collection of bits.

disk or diskette: Magnetic medium for data storage. Either "floppy" diskettes (720K to 1.4 megabytes), or "hard" disks (usually upward from 20 megabytes).

DOS: Acronym for "disk operating system" usually referring to the operating system used on "IBM-compatible" computers.

download: To transfer information from an on-line network onto a user's personal computer. This may be done for conference or e-mail messages which need to be printed, copied to diskette, or simply browsed at leisure.

e-mail: Electronic mail.

editor: An on-line program to write or change a conference or e-mail message; a simple on-line word processor.

electronic mail: The transfer of messages between you and other users of on-line network systems. E-mail is similar to an ordinary letter: you supply the address of the recipient(s) and the text of the message. It is different in that delivery takes place in minutes or hours rather than days. Electronic mail provides private (or, in some cases, restricted-group) communications.

emotion: See *smiley*.

error checking: Uploading or downloading transfer check employed to identify errors in data transmission.

enter: The <ENTER> key on your keyboard. Almost all commands used on a network should be followed by <ENTER>. Also called <return>, <CR>, or carriage return.

Ethernet: See *local area network*.

facilitator: A network user who is responsible for a particular conference.

file: A named group of characters or data bits in your computer or on the network. Files in a computer are similar to file folders in a filing cabinet.

file format: The type of file, such as picture or text; represented as a suffix at the end of the filename (text = TXT or .txt, etc.).

file server: A computer designated to store software, courseware, administrative tools, and other data on a local- or wide-area network. It "serves" this information to other computers via the network when users enter their personal access codes.

flame: A virulent and often personal attack against the author of a conference posting; flaming is a breach of netiquette.

floppy disk: See *disk*.

folder: A "folder" is a place where a user's e-mail messages may be stored. Every user has a folder for new messages, and on most systems may create other folders for specific purposes.

font: The name used to describe a family of characters with distinctive shapes. Examples: Palatino and Avant Garde are "proportional fonts," whereas Courier and Monaco are "non-proportional" and, when printed, will faithfully reproduce the look of the text you see on-line.

freeware: Software that is distributed for free, with no license fee.

FTP: File transfer protocol. One of the basic Internet tools, which allows high-speed exchange of files between computers connected to the Internet.

full duplex: Communication providing simultaneous sending and receiving.

gateway: An electronic door between one computer network and another.

Gopher: A program available via the Internet that allows users to review and retrieve information on other host systems via easy-to-use menus.

gopherspace: Where you are when you're using a Gopher program.

GUI: Graphical user interface; pronounced "gooey." A way of interacting with a computer that replaces typed text commands with menus or graphical icons activated with a pointing device such as a mouse.

graphics: Computer-generated art and illustrations.

half duplex: Communication that alternates between sending and receiving.

handshaking: A procedure performed by modems, terminals, and computers to verify that communication has been correctly established.

hang: When a computer freezes, so that it does not respond to keyboard commands, it is said to "hang" or to have "hung."

hard copy: A printout of a computer file; a printed version of anything.

hard disk or hard drive: See *disk*.

hardware: Physical electronic devices such as computers, printers, keyboards, modems, or cables.

Hayes modem: Most modems in use today are "Hayes-compatible" modems, with a standard set of alphanumeric commands.

help: Users in need of help can often issue a command such as "?" to access on-line help and tutorial systems.

icons: On-screen pictures that symbolize various commands.

IGC: Institute for Global Communications, the U.S. member of the APC (Association for Progressive Communications), and provider of EcoNet, PeaceNet, and ConflictNet. Its Internet address is igc.apc.org. For information, send e-mail to <igcoffice@igc.apc.org> or call (415) 442-0220.

index: An "index" is a list of the messages contained in a conference or a mail folder. Indexes generally show the date of the message, its title (or subject), the name of the user who wrote it, and an indication (with a "*" marker) of whether you have read that message.

interactive multimedia: See multimedia.

Internet: The interconnected global network of computers that use the same set of software protocols (called TCP/IP) for exchanging e-mail, file transfers (via FTP), and remote logins to other host systems (via telnet). With a small "i," internet refers to any system of interconnected networks.

K: Kilobyte.

Kermit: A communications protocol that allows you to transfer files between your computer and on-line network systems. Kermit has built-in error correction and can handle binary (non-text) files.

keyboard: Similar to a typewriter, contains the letters for typing text, and keys that give the computer its commands.

kilobyte (K): 1,000 bytes.

LAN: Local area network. A school's LAN includes all the computers in the school that are hooked together (usually by cables) to share files and applications.

laserdisc: Large, metallic-looking records about the size of 33 RPM albums (12 inches in diameter), sometimes called videodiscs. Laserdiscs can store a vast amount of information in text, sound, and images. To play a laserdisc, you need a laserdisc player and either a computer monitor or television set. Laserdiscs come in two formats. CLV (constant linear velocity) is accessed by time and CAV (constant angular velocity) is accessed by frame number.

laserdisc player: A self-contained unit approximately the size of a videocassette recorder (VCR) that plays laserdiscs. Typically used in education for movies or interactive multimedia courseware. Their primary advantage over VCRs as a video playback unit is their ability to provide quick random access to any location on the laserdisc within seconds.

LISTSERV: Automated mailing list server software, used to manage specialized e-mail lists.

local area network (LAN): A network of computers at a single site. The two most common school networking configurations are called Ethernet and token ring, referring to the technical aspects of how the computers and file servers are connected. Also see network.

log in: Making the phone connection to a network system. Sometimes called "log on."

log off: Leave a network system, usually by typing "bye" or "q" for quit. Sometimes called "log out."

log-in ID: Same as account name or user ID.

mail: In the world of computer networking, "mail" refers to electronic mail, or e-mail.

mainframe, minicomputer, microcomputer: Three sizes of computers. Big corporations use mainframes and large school systems might use a mid-range computer, sometimes called a minicomputer, as a file server and administrative tool. The correct term for microcomputer is personal computer or PC.

megabyte (MB): 1 million bytes (or 1,000 K), about 500 pages of text.

memory: Your computer's temporary storage capacity, measured in kilobytes (KB) or megabytes (MB) of RAM (random-access memory). Long-term data storage on discs, is also measured in kilobytes or megabytes.

menu: A list of selectable network functions. A "main menu" usually leads to other menus or command options.

message: Any message carried on the network, including conference topics and responses, and e-mail.

microcomputer: See *mainframe*.

microprocessor: Main computer chip that provides speed and capabilities of the computer. Also called CPU.

minicomputer: See *mainframe*.

MNP: Microcom network protocol. Error-checking, and compression routines that make modems communicate faster and more reliably.

modem: A device used to connect a computer through the telephone system to another computer. A modem can dial a number, answer a call, and hang up; but the "conversations" it carries are strictly computer-to-computer. Modems have different maximum speeds, which are indicated by their baud rate. The term modem is a conjunction of two words: MODulator/DEModulator.

modem setup: Modem speed, parity, data bits, stop bits, and duplex must be set the same at the user's computer as at the network system. Communication software is used to set up the modem.

monitor: A television-like screen that shows text, graphics, and other functions performed by the computer.

Mosaic: A GUI for browsing the World Wide Web and gopherspace.

mouse: A pointing device used as an alternative to keyboard control for positioning the cursor and interacting with a GUI. With a mouse plugged into your computer, you can guide the blinking light on-screen (the cursor) to draw, move data, and open and close files. "Clicking" the mouse means pushing the mouse's button to highlight or activate a particular file or activity.

multimedia: The delivery of information using two or more formats, including text, graphics, audio, still images, music, animation, and motion video. Today, the term implies "interactive multimedia" in which these various types of information are presented interactively by a computer in response to user input.

netiquette: Network etiquette; commonly accepted rules of on-line behavior.

network: A collection of two or more computers interconnected by telephone lines, coaxial cables, satellite links, radio, and/or some other communication technique. A computer "network" is a group of computers which are connected together and which communicate with one another for a common purpose. Computer networks support "people and organization" networks, users who also share a common purpose for communicating.

node: A central computer in a computer network; also called a "host" or "server."

off-line: Not connected to a network. You can save money on pay-for-use networks by preparing your messages off-line using your word-processing software, and uploading them instead of typing them in while you're connected to (or on-line with) the network.

on-line: Connected to a network or via a network. Examples: Send me a message on-line. In other words, send me an e-mail message.

packet: A bundle of data. On the Internet, data is broken up into small chunks called packets that each traverse the network independently.

parameter: A setting for a modem or communication software.

parity: A setting of a terminal or modem related to the type of error correction system used when connected to a network.

password: A group of characters known only to you that must be entered as part of logging in to a network; also called "key." The password guarantees that only you can access your account.

peripheral: Anything extra or added on for your computer, such as a modem, a mouse, or a fax adapter. Peripherals can be added on externally or installed inside the machine.

personal computer (PC): Microcomputer.

port: The plug to enable interface from computer to other pieces of hardware, e.g. hard disk, scanner, modem, mouse. Also used as a verb, "to port", meaning to move a file from one computer system, network, or conference to another.

post: The act of placing a message in an on-line conference. The noun "posting" is sometimes used to refer to a conference message.

program: A set of computer instructions (software) for carrying out a given task.

program disk: A disk containing software programs.

prompt: A message that appears on the screen while a network system is waiting for you to enter a command or option.

protocol: A definition of how computers will act when they talk to one another.

RAM: Random-access memory. A way to measure how much information the computer's memory can hold and work with.

ROM: Read-only memory. Information is stored once, usually by the manufacturer, that cannot be changed. Most compact discs are ROM.

resource: An on-line information set or an on-line interactive option. An on-line library catalog or the local school lunch menu are examples of information sets. On-line menus or graphical user interfaces, Internet e-mail, on-line conferences, telnet, FTP, and Gopher are examples of interactive options.

response: A message placed in a conference as a follow-up to a topic or to another response; or, a reply to an e-mail message.

return: See *enter*.

service: (or service provider) An organization that provides access to part of the Internet. You have to arrange for an account with a service to connect your computer to the Internet.

session: The time period between when you "log in" and "log off" to a network system.

shareware: Software distributed freely on the "honor system," trusting people to pay the authors a license fee when the software is used.

smiley: Character combinations such as :-) to denote whether a message is being made in jest with various modifications thereof ;-) to wink, etc. Also called emoticons, since not all are smiling %-(.

software: Computer programs that perform various tasks. Word processing programs (like WordPerfect or Microsoft Word), spreadsheet programs (like Lotus or Excel), or database programs (like dBase III+, Foxbase, or FileMaker) are all software.

spreadsheet: Software program that allows mathematical calculations, such as budgeting, keeping track of investments, or tracking grades.

soft copy: An electronic version of a file, usually in computer memory and/or on disk; as opposed to hard copy, the paper printout.

string: A series of two or more text characters.

TCP/IP: Transmission Control Protocol/ Internet Protocol. The communication protocols on which the Internet is based.

telecommunication: Communicating with other people through the computer using communication software and modems.

telecomputing: Using computers for telecommunication; computer networking.

telnet: A program that allows users on the Internet to log in to remote systems from their own host system.

terminal: A device connected to a computer network that acts as a point for entry or retrieval of information. Personal computers can be made to act as network terminals, by running terminal emulation (communication) programs.

text: A string of characters. A text file should contain only characters — as opposed to codes or commands.

thread: A conference topic with multiple responses or a sequence of e-mail messages with the same subject.

time out: What happens when two computers are talking and one fails to respond within a certain time, for whatever reason.

toggle: Using one command or keystroke to change between one mode and its opposite.

topic: In a conference, a message which is generally written to convey a new idea or a new piece of information, relevant to that conference.

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UNIX: A popular computer software operating system used on many Internet host systems.

Usenet: An information cooperative linking around 16,000 computer sites and about 1 million people. Usenet provides a series of "news groups" analogous to online conferences.

user: Network user.

user ID: Account name.

username: Account name or user ID.

v.32, v.32bis, v.42, v.42bis: Error-correction and data compression protocols that make modems communicate more quickly and reliably.

vt100: A terminal-type setting; with this setting a network system assumes you are using a VT100 terminal or a computer program that acts like one.

Veronica: Archie-like program used to search Gopherspace.

videodisc: See *laserdisc*.

virus: A computer virus is an insidious piece of software that infects other software and moves from computer to computer when software is transferred. A virus may compound itself once it's inside your computer, thereby destroying software programs and a great deal of data, or it may do other nasty things. Some viruses are benign. Modems can transmit viruses, but illegally copied or "bootleg" diskettes are the most likely carriers. Virus protection software is the best defense, and is available commercially or as freeware/shareware.

WAIS: Wide-area information server, a standard for indexed full-text retrieval via the Internet.

word processor: A program used to enter or edit text information in personal computers, often used to create a file before it is uploaded to a network; may also be used to process text after it has been downloaded.

World Wide Web (WWW): A hypertext-based system for finding and accessing Internet resources.

xmodem: A communications protocol that allows you to transfer files between your computer and a network with error correction.

zmodem: Another error-checking file transfer protocol faster than xmodem or Kermit.

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